

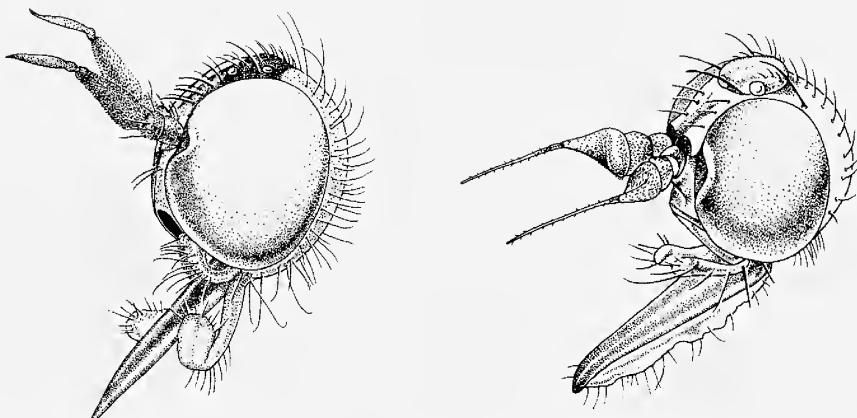
# RECORDS OF THE AUSTRALIAN MUSEUM

Volume 60

Number 1

25 June 2008

New species of <i>Austrothaumalea</i> Tonnoir from Australia (Diptera: Thaumaleidae) ... .....	BRADLEY J. SINCLAIR	1
A new subfamily of spiders with grate-shaped tapeta from Australia and Papua New Guinea (Araneae: Stiphidiidae: Borrallinae) .....	MICHAEL R. GRAY & HELEN M. SMITH	13
Trapdoor Spiders of the genus <i>Misgolas</i> (Mygalomorphae: Idiopidae) from eastern New South Wales, with notes on genetic variation .....	GRAHAM WISHART & DAVID M. ROWELL	45
A reassessment of <i>Saluarius swaini</i> (Lacertilia: Diplodactylidae) in southeastern Queens- land and New South Wales; two new taxa, phylogeny, biogeography and conservation .....	PATRICK J. COUPER, ROSS A. SADLER, GLENN M. SHEA & JESSICA WORTHINGTON WILMER .....	87



nature culture discover



© 2008 Australian Museum  
The Australian Museum, Sydney

No part of this publication may be reproduced without permission of The Editor.

Volume 60 Number 1

Published 25 June 2008

Price: AU\$50.00

Printed by RodenPrint Pty Ltd, Sydney

ISSN 0067-1975

The Australian Museum is a statutory authority of, and principally funded by, the NSW State Government.



*Cover images*—Comparison of related kinds is an essential aspect of discovery in the natural sciences. In the example shown on the cover, Australian Museum entomologist Dan Bickel has described two new genera of empidid flies on the basis of comparative studies involving many hundreds of Museum specimens. The two images on the cover are the very different heads of *Eugowra uniseta* and *Munburra bulbicornis*, described by him, and illustrated by Hannah Finlay, in *Records of the Australian Museum* volume 58 (2006).

Since 1999 the primary scientific literature published in print by the Australian Museum has also been freely accessible online at our website. Earlier works are continually being added and by 2009 the entire legacy of *Records of the Australian Museum*, back to volume 1 of 1889, will be digitized and made freely available online.

*Records of the Australian Museum* is covered in the Thomson Scientific services: Current Contents® / Agriculture, Biology, and Environmental Sciences, and Science Citation Index Expanded (also known as SciSearch®)

We encourage cross-linking in the scientific literature by applying *doi* registration to AM publications via CrossRef®

The Australian Museum houses some of the world's most important collections of Australian animal, fossil and geological specimens and cultural objects. Research on these millions of specimens and artefacts yields insights into how our world changes through time and how its diversity can be classified and interpreted. This knowledge, when shared among the scientific and broader community—initially through publication—helps us understand human impact on our environment and what reasonable steps society can take now for the well-being of future generations. Our responsibility is to inspire the exploration of nature and cultures; our vision is a beautiful and sustainable natural world with vibrant and diverse cultures.

Since 1889 the *Records of the Australian Museum* (ISSN 0067-1975) has published the results of studies that derive in large part from Australian Museum collections or studies that more generally lead to a better understanding of nature and cultures in the Australasian region. Issues of the *Records* are published three times a year and circulated to 84 countries. All that is published in print is, soon afterwards, also freely available online. *Records of the Australian Museum*, volume 58, was published in 2006, volume 59 in 2007. Monographic works of particular significance are published irregularly as *Records of the Australian Museum, Supplements*.

Catalogues, lists and databases have, in the past, been published in print as numbered *Technical Reports of the Australian Museum* (ISSN 1031-8062 print). From number 20 (December 2007) onwards, *Technical Reports of the Australian Museum* (ISSN 1835-4211 online) will be published online only. *Australian Museum Memoirs* (ISSN 0067-1967) ceased in 1983.

Librarians or publishers of similar scientific and academic journals may propose exchange agreements with the *Australian Museum Research Library*. Back issues are available for purchase direct from the *Australian Museum Shop*. Subscription to *Records of the Australian Museum* is available.

Back issues may be purchased from the Australian Museum Shop  
[www.australianmuseum.net.au/shop](http://www.australianmuseum.net.au/shop)

Authors are invited to submit manuscripts to The Editor. Manuscripts meeting subject and stylistic requirements outlined in the *Instructions to Authors* (see inside back cover) are assessed by external referees.

Dr Shane F. McEvey  
The Editor, *Records of the Australian Museum*  
Australian Museum  
6 College Street  
Sydney NSW 2010, Australia  
[editor@austmus.gov.au](mailto:editor@austmus.gov.au)

[www.australianmuseum.net.au/publications/](http://www.australianmuseum.net.au/publications/)



Our logo is based on a distinctive and local Aboriginal rock engraving of the echidna. This image has special meaning for the Australian Museum as it represents both nature and culture—a fitting symbol for all that we do.

## New Species of *Austrothaumalea* Tonnoir from Australia (Diptera: Thaumaleidae)

BRADLEY J. SINCLAIR

Entomology—Ontario Plant Laboratories, Canadian Food Inspection Agency,  
K.W. Neatby Bldg., C.E.F., 960 Carling Ave., Ottawa, ON Canada K1A 0C6, Canada  
sinclairb@inspection.gc.ca

**ABSTRACT.** Seven new eastern Australian species of *Austrothaumalea* Tonnoir are described (*A. bicornis*, *A. bifida*, *A. concava*, *A. queenslandensis*, *A. ramosa*, *A. theischingeri*, *A. uloola*). Notes and new collection records of previously described Australian species of *Austrothaumalea* and *Niphta* Theischinger are listed and an updated key to all described Australian species of *Austrothaumalea* provided. Assignment of species of *Austrothaumalea* to species groups is also presented. The known distribution of eastern Australian Thaumaleidae is extended to northern Queensland.

SINCLAIR, BRADLEY J., 2008. New species of *Austrothaumalea* Tonnoir from Australia (Diptera: Thaumaleidae). *Records of the Australian Museum* 60(1): 1–12.

In the Australasian region, three genera of Thaumaleidae (Diptera) are known: *Austrothaumalea* Tonnoir, *Niphta* Theischinger and *Oterere* McLellan (Theischinger, 1986; McLellan, 1988). *Niphta* is a small genus with three Australian and one South American species (Theischinger, 1986). It is possibly most closely related to *Afrothaumalea* Stuckenbergs (Sinclair & Stuckenbergs, 1995). *Oterere* is known from one New Zealand species and one South American species and appears most closely related to *Austrothaumalea*. There are ten species of *Austrothaumalea* from New Zealand, three from South America, one species from New Caledonia (Sinclair, in press), and prior to this study, 19 species from Australia.

In Australia, one species of *Austrothaumalea* is confined to the southwest, four species confined to Tasmania and the remaining species prior to this study were found from Victoria to southern Queensland (Theischinger, 1986). To my knowledge there are currently no records of thaumaleids from northern Queensland. In this study, seven new species of *Austrothaumalea* are described, the key to Australian species is updated to include these new species and new collection records are listed for previously described Australian species.

### Materials and methods

Terms used for adult structures primarily follow those of J.F. McAlpine (1981), except wing venation where the interpretations of Colless & D.K. McAlpine (1991, fig. 39.17F) and Saigusa (2006) are accepted. Homology of the male terminalia follows that of Sinclair (1992). All specimens in this study were collected by the author.

This study is based on more than 350 adult specimens deposited in the following institutions: Australian Museum, Sydney (AMS); Australian National Insect Collection, Canberra (ANIC); Canadian National Collection of Insects, Ottawa, Canada (CNC); Zoologisches Forschungsmuseum Alexander Koenig, Bonn, Germany (ZFMK). Label data for primary types are cited in full, with labels listed from the top downward, and data from each label enclosed in quotation marks. Labels are cited in full, in original spelling, punctuation and date, and lines are delimited by a slash mark (/). Additional information is included in [square] brackets. The repository of each type is given in parentheses. Secondary type data are abridged and listed alphabetically.

The above abbreviations are used throughout the text to

indicate deposition of specimens. The following abbreviations are used in the material examined sections: *Ck*, creek; *Lk*, lake; *NP*, National Park; *nr*, near; *Pk*, park; *R*, river; *SF*, State Forest; *SP*, State Park; *temp. rainfor.*, temperate rainforest.

In Australia, thaumaleids were collected anywhere permanent water was flowing, and this included wet rainforests to dry sclerophyll forests and from lowlands to uplands. Adults were collected by sweeping cascading streams, edges

of waterfalls, seepages and associated riparian vegetation. Larvae were observed in seepages and splash zones of emergent boulders in streams.

For best results, adult thaumaleids should be collected into 75% ethanol and later critical-point-dried. Dissection is much easier and details of the male terminalia in mounted specimens are often more readily observed when the material is prepared in this way.

### Key to males of Australian species of *Austrothaumalea* (modified from Theischinger, 1986)

1	$R_{4+5}$ with macrosetae .....	<i>A. tasmanica</i> Theischinger
—	$R_{4+5}$ lacking macrosetae .....	2
2	Gonostylus branched or forked (Fig. 3) .....	3
—	Gonostylus simple, unbranched, lacking additional lobes (Fig. 2) .....	5
3	Apex of paramere forked; inner lobe of gonostylus short, not longer than wide; apex of epandrium prolonged (Fig. 3) .....	<i>A. bifida</i> n.sp.
—	Apex of paramere simple; inner lobe of gonostylus longer than wide; apex of epandrium truncate (Theischinger, 1986, fig. 18) .....	4
4	Length of outer branch of gonostylus more than twice width .....	<i>A. cervulus</i> Theischinger
—	Length of outer branch of gonostylus less than twice width .....	<i>A. uptoni</i> Theischinger
5	Western Australian species .....	<i>A. australis</i> Theischinger
—	Eastern Australian species .....	6
6	Epandrium (tergite 9) with apical or lateral processes .....	7
—	Epandrium lacking apical and lateral processes .....	17
7	Epandrial processes produced apically (Figs 1, 2) .....	8
—	Epandrial processes produced laterally (Figs 10, 12) .....	11
8	Epandrial processes long and very slender (Fig. 1), more than three times as long as basal width .....	9
—	Epandrial processes very short and subtriangular, slightly longer than basal width .....	<i>A. bickeli</i> Theischinger
9	Gonostylus bent nearly at right angles at mid-length, apex expanded slightly (Figs 1–2) .....	<i>A. bicornis</i> n.sp.
—	Gonostylus curved evenly throughout, apex tapered .....	10
10	Gonocoxal plate prolonged apically, arrowhead-shaped; epandrium with broad, rounded lateral lobe posterior to gonocoxite .....	<i>A. minnamurrae</i> Theischinger
—	Gonocoxal plate truncate apically, with pair of short, slender apicolateral processes; lateral margin of epandrium slightly expanded, lacking distinct prolongation .....	(Woombye, Qld) <i>Austrothaumalea</i> sp. [see Remarks section for <i>A. minnamurrae</i> ; Theischinger, 1986: 304]
11	Gonostylus curved evenly throughout (Figs 9, 11) .....	12
—	Gonostylus bowed strongly near mid-length, basal and apical portions almost straight (Theischinger, 1986, fig. 38) .....	16
12	Paramere long, slender and sword-like, approximately 2× length of gonocoxal plate; gonocoxal plate bearing apicolateral crown of pointed projections .....	13
—	Paramere short, laterally flattened with rounded apex, at most 1.5× length of gonocoxal plate; gonocoxal plate lacking crown of pointed projections or only forked processes apicolaterally (Figs 9, 11) .....	15

13 Epandrium narrowly produced between lateral processes, longer than wide; lateral processes arching inwards to oppose each other ..... *A. spinosa* Theischinger

— Epandrium broadly extended beyond lateral processes; lateral processes not arching inwards to oppose each other ..... 14

14 Lateral processes of epandrium long and horn-like; gonocoxal plate with apicolateral spine-like processes; anterior margin of hypandrium partially U-shaped; apex of gonostylus smooth ..... *A. capricornis* Theischinger

— Lateral processes of epandrium short and subtriangular; gonocoxal plate umbrella-shaped, lacking spines; anterior margin of hypandrium deeply U-shaped; apex of gonostylus slightly notched ..... *A. victoriae* Theischinger

15 Gonocoxal plate tapered apically with cup-like depression (Fig. 11) ..... *A. uloola* n.sp.

— Gonocoxal plate with pair of forked apicolateral processes (Fig. 9) ..... *A. theischingeri* n.sp.

16 Lateral processes of epandrium long and horn-like, subequal to width of apical lobe ..... *A. similis* Theischinger

— Lateral processes of epandrium short and subtriangular; shorter than width of apical lobe ..... *A. denticulata* Theischinger

17 Gonostylus strongly bent near mid-length or apical two-thirds (Fig. 8) ..... 18

— Gonostylus curved evenly throughout (Fig. 4) ..... 19

18 Base of gonostylus roundly expanded; apical epandrial margin straight; gonocoxal plate with small apicolateral knobs ..... *A. macalpinei* Theischinger

— Base of gonostylus not expanded; apical epandrial margin slightly notched; gonocoxal plate with long, antler-like processes (Fig. 8) ..... *A. ramosa* n.sp.

19 Gonostylus tapered evenly throughout (Fig. 4) ..... 20

— Gonostylus nearly parallel-sided for about basal two-thirds; apical third abruptly reduced and slender (Theischinger, 1986, fig. 23) ..... 26

20 Paramere with subapical pair of slender coiled processes ..... *A. simplex* Theischinger

— Paramere simple, straight, lacking processes ..... 21

21 Posterior margin of epandrium with narrow U-shaped median excision ..... *A. sinuosa* Theischinger

— Posterior margin of epandrium lacking narrow excision, straight ..... 22

22 Posterior margin of epandrium broadly infolded (Fig. 5), apex somewhat narrowed and broadly pointed; apex of paramere setose; inner margin of gonocoxal lobes deeply concave (Fig. 4) ..... *A. concava* n.sp.

— Posterior margin of epandrium not infolded, apex nearly straight; apex of paramere bare; inner margin of gonocoxal lobes nearly straight or only slightly concave (Fig. 6) ..... 23

23 Apex of gonocoxal plate apparently deeply Y-shaped, although membranous sheet connecting arms may be visible (Fig. 6) ..... 24

— Apex of gonocoxal plate truncate, not apparently Y-shaped ..... 25

24 Apex of paramere straight; gonocoxal plate with pair of apicolateral, knob-like processes; posterior margin of epandrium somewhat roughened or uneven with several small knobs (Fig. 6) ..... *A. queenslandensis* n.sp.

— Apex of paramere slightly twisted and hooked ventrally; gonocoxal plate lacking apicolateral, knob-like processes; posterior margin of epandrium straight or with shallow depression, lacking knobs ..... *A. zentae* Theischinger

25 Gonocoaxal plate umbrella-shaped; epandrium very short, only slightly longer than tergite 8 ..... *A. barrydayi* Theischinger

— Gonocoaxal plate nearly square, truncate; epandrium longer than tergite 8 ..... *A. fusca* Theischinger

26 Posterior margin of epandrium trapezoidal with rounded posterior corners; apical margin infolded; paramere long and slender, more than 2× length of gonocoaxal plate; gonocoaxal plate slightly prolonged apicolaterally ..... *A. tonnoiri* Theischinger

— Posterior margin of epandrium narrowed apically, with pair of very small triangular lateral processes; paramere not more than 2× length of gonocoaxal plate; gonocoaxal plate Y-shaped, with lateral arms arched around paramere bearing finger-like processes ..... *A. commoni* Theischinger

## Taxonomy

### Genus *Austrothaumalea* Tonnoir

*Austrothaumalea* Tonnoir, 1927: 109

The genus *Austrothaumalea* is characterized by absence of a distinct ridge (supra-alar region) in front of the wing, microtrichia of first vein ( $R+R_1+R_{1+2}$ ) extending length of vein, crossvein closer to apex of  $R_{1+2}$  than to origin of  $R_3$ ,  $R_3$  often with arch strongly produced, basal appendage of CuA often present, gonocoxites slender, longer than wide and hypandrium broad.

#### *Austrothaumalea barrydayi* Theischinger

*Austrothaumalea barrydayi* Theischinger, 1986: 297

**Material examined.** New South Wales: 1♂, Blue Mtns NP, Blackheath, Govetts Leap, 17.x.2002 (ZFMK); 3♂♂, Blue Mtns NP, Blackheath, Grose Gorge, Govetts Ck, 1.xii.1993 (ANIC); 5♂♂, 1♀♀, Blue Mtns NP, Blackheath, Popes Glen Ck, 1000 m, 31.x.1994 (AMS); 9♂♂, 1♀♀, Blue Mtns NP, Valley of the Waters, below Vera Falls, 320 m, 9.iv.1995 (AMS); 1♂, same locality, 23.x.1994 (CNC); 5♂♂, Wentworth Falls, Jamison Ck & seeps, 10.xi.1993, 23.x.1994 (CNC).

**Distribution.** This species is known from the southern half of eastern New South Wales.

**Remarks.** The gonocoaxal plate bears a crown of minute denticles along the ventral margin, directed anteriorly and is not shown in Theischinger (1986, fig. 8).

#### *Austrothaumalea bickeli* Theischinger

*Austrothaumalea bickeli* Theischinger, 1988: 212.

**Material examined.** New South Wales: 2♂♂, Barrington Tops NP, Williams R, 480 m, subtrop. rainfor., 19.xii.1993 (AMS, CNC).

**Distribution.** This species remains known only from Barrington Tops National Park.

#### *Austrothaumalea bicornis* n.sp.

Figs 1–2

**Type material.** HOLOTYPE ♂ “AUST: N.QLD: Mt. /Elliot N.P., 600 m /above Alligator Ck. /Falls, 9.iv.1994; seep /B.J. Sinclair”; “HOLOTYPE /*Austrothaumalea /bicornis /Sinclair*” (AMS). PARATYPES: **Queensland:** 1♂, same data as holotype (AMS).

**Recognition.** This species is distinguished by the strongly bent gonostyli and pair of long, slender apical epandrial processes.

**Description.** Wing length 1.5 mm. **Coloration:** Head dull, dark brown. Mesonotum and pleura dark brown and dull; coxae, femora and tibiae pale brown, tarsi darker; halter knob pale on inner margin; abdomen dull greyish-brown, including pleural membrane; terminalia dark brown. Wing faintly infuscate;  $R+R_1+R_{1+2}$  with macrotrichia along entire length, remaining veins bare;  $R_2$  situated in middle of  $R_{1+2}$ ; bend in  $R_3$  strong;  $R_3$  and  $R_{4+5}$  somewhat divergent toward wing margin; CuA nearly straight, lacking appendage. **Male abdominal sternites** 2–7 rectangular, sparsely setose; sternite 8 membranous. **Male terminalia** (Figs 1–2): Epandrium broadly triangular from ventral aspect; posterior margin narrow, straight; pair of long, slender processes projecting from posterolateral margin. Hypandrium broad, less than width of base of gonostylus. Gonocoxite long, slightly tapered apically. Gonostylus bent at right angle near mid-length; apex flattened, spatula-shaped from posterior view; lacking setulae beyond bend. Parameres fused to form laterally flattened process, with hooked tip; not extending beyond gonocoxites. Gonocoaxal plate broad, extending to mid-length of gonocoxites; apical margin convex, with short posterolateral processes; not fused to hypandrium.

**Distribution.** This species is known only from its type locality (just south of Townsville, Queensland), collected from a seepage flowing over a large open rock bald next to the falls of Alligator Creek. Mount Elliot is a granite massif, arising more than 1000 m. Its eastern slopes bear numerous small creeks and waterfalls. A small remnant rainforest is confined to areas above 600 m.

**Remarks.** This species appears most closely related to *A. minnamurrae* and the undescribed species from Woombye referred to in Theischinger (1986).

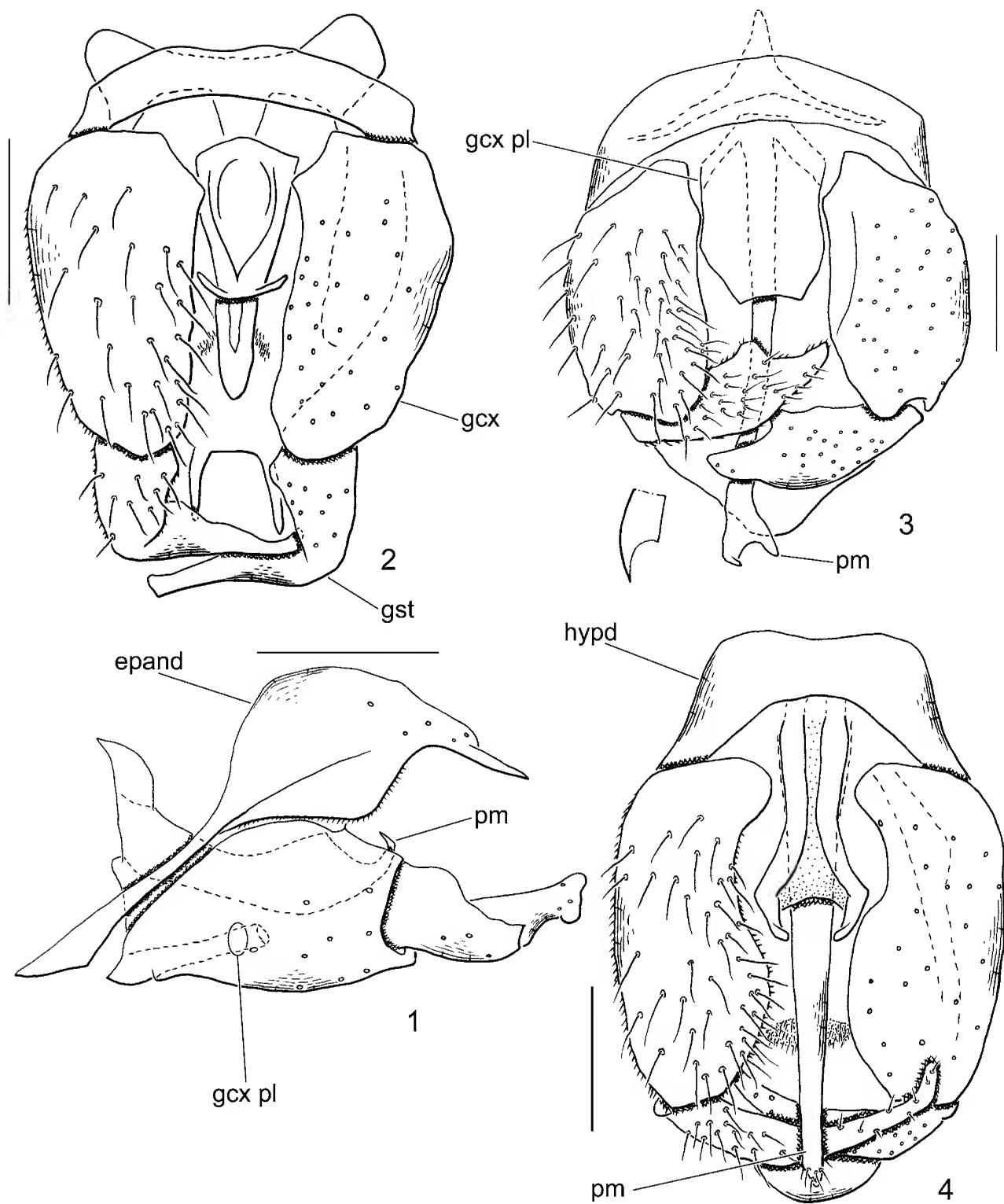
**Etymology.** The specific name is from the Latin *cornis* (horned), in reference to the pair of long slender projections from the posterior margin of the epandrium.

#### *Austrothaumalea bifida* n.sp.

Fig. 3

**Type material.** HOLOTYPE ♂ “AUST: N.QLD: Mt. /Elliot N.P., 600 m /above Alligator Ck. /Falls, 9.iv.1994; seep /B.J. Sinclair”; “HOLOTYPE /*Austrothaumalea /bifida /Sinclair* [dissected]” (AMS). PARATYPES: **Queensland:** 1♂, 5♀♀, same data as holotype (AMS).

**Recognition.** This species is distinguished by the bifid gonostyli and forked apex of the paramere.



Figs 1–4. Male terminalia of *Austrothaumalea*: (1) *A. bicornis*, lateral view; (2) *A. bicornis*, ventral view; (3) *A. bifida*, ventral view (holotype), tip of paramere from paratype; (4) *A. concava*, ventral view. Scale bar = 0.1 mm. Abbreviations: *epand*, epandrium; *gcx*, gonocoxite; *gcx pl*, gonocoxal plate; *gst*, gonostylus; *hypd*, hypandrium; *pm*, paramere.

**Description.** Wing length 1.7–2.0 mm. **Coloration:** Head dull, dark brown. Mesonotum and pleura dark brown and somewhat shiny; coxae, femora and tibiae pale brown, tarsi darker; halter knob pale on inner margin; abdomen dull greyish-brown, including pleural membrane; terminalia

generally dark. Wing faintly infuscate;  $R+R_1+R_{1+2}$  with macrotrichia along entire length, remaining veins bare;  $R_2$  situated towards apex of  $R_1$ ; bend in  $R_3$  gentle, not strongly defined;  $R_3$  and  $R_{4+5}$  divergent toward wing margin;  $CuA$  with short basal appendage. **Male abdominal sternite 1,**

narrow, spectacle-shaped; sternite 2 reduced to slender, median sclerite, with pair of small, posterolateral sclerites; sternites 3–6 rectangular, sparsely setose; sternite 7 narrow, one-half length of sternite 6; sternite 8 reduced to Y-shaped sickle. *Male terminalia* (Fig. 3): Epandrium broadly triangular from ventral aspect; posterior margin narrow, evenly rounded; lacking pointed posterolateral processes. Hypandrium broad, less than width of base of gonostylus. Gonocoxite long, slightly expanded apically. Gonostylus mitten-shaped; thumb-like appendage short, truncate; apical process tapering and lacking setulae. Parameres fused to form long tube, arching dorsally, with abrupt subapical bend directly posteriorly; apex broadly forked (holotype) or sickle-shaped (paratype); extending beyond epandrium. Gonocoxal plate broad; apical margin concave, generally very pale; not fused to hypandrium.

**Distribution.** This species was collected from the same site as *A. bicornis*, south of Townsville, Queensland.

**Etymology.** The specific name is from the Latin *bifidus* (bifurcated), referring to the apex of the paramere.

**Remarks.** This species appears to be closely related to *A. cervulus* and *A. uptoni* on the basis of their bifid gonostylus and truncate gonocoxal plate. The apex of the paramere of *A. bifidus* differs between the holotype (forked) and paratype (sickle-shaped) (Fig. 3), a similar variation in the apex of the paramere was also noted in *A. commoni* (Theischinger, 1986, figs 25–26).

### *Austrothaumalea capricornis* Theischinger

*Austrothaumalea capricornis* Theischinger, 1986: 298.

**Material examined.** New South Wales: 3♂♂, 1♀, Blue Mtns NP, Mt. Wilson, Waterfall Ck, 22.xi.1993, 13.xii.1998 (AMS, CNC).

**Distribution.** This species is known from Mt. Wilson and the Point Lookout region of New England National Park.

**Remarks.** The above specimens from Mt. Wilson were collected either along a narrow cascading stream or at the waterfall near the edge of the forested region. This locality is a small remnant rainforest growing in rich basaltic soils, and near the stream is a large grove of tree ferns (*Dicksonia antarctica* Labill).

### *Austrothaumalea cervulus* Theischinger

*Austrothaumalea cervulus* Theischinger, 1986: 298.

**Material examined.** New South Wales: 1♂, 2♀♀, Sydney, Edgecliff, Trumper Pk, cliff seepage, 9.x.1994 (AMS).

**Distribution.** This species is known only from east of the Blue Mountains, in the Sydney, Royal National Park region.

**Remarks.** The paramere of *A. cervulus* bears a pair of subapical fang-like lateral processes, directed anteriorly, which are not shown in Theischinger (1986, fig. 18).

### *Austrothaumalea commoni* Theischinger

*Austrothaumalea commoni* Theischinger, 1986: 300.

**Material examined.** New South Wales: 1♂, Kosciusko NP, Thredbo, roadcut seeps, 1300 m, 28.xi.1994 (AMS).

**Distribution.** This species is known from southeastern New South Wales.

### *Austrothaumalea concava* n.sp.

Figs 4–5

**Type material.** HOLOTYPE ♂ “AUST: QLD: Bunya /Mtns NP, Paradise /Falls, 8.x.2002 /B.J. Sinclair”; “HOLOTYPE /Austrothaumalea /concava /Sinclair” (AMS). PARATYPES: New South Wales: 1♂, Dorrigo NP, Wonga Walk, 700 m, Crystal Shower Falls, 2.iv.1995, B.J. Sinclair (AMS). Queensland: 18♂♂, 8♀♀, same data as holotype (AMS, ANIC, CNC, ZFMK).

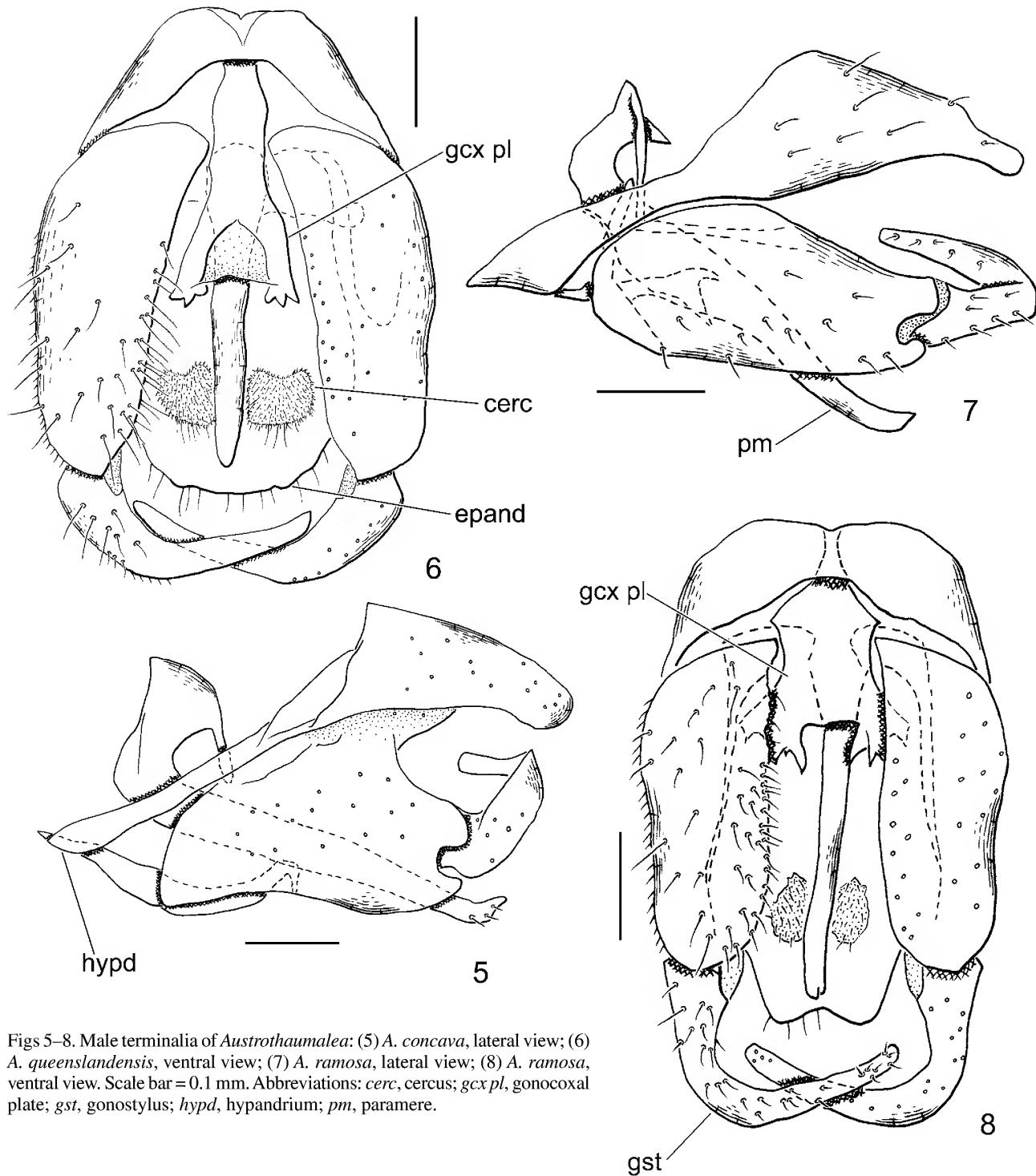
**Recognition.** This species is distinguished by the concave inner margin of the gonocoxites, folded apical margin of the epandrium and short forked apex of the gonocoxal plate.

**Description.** Wing length 2.2 mm. *Coloration:* Head dull, dark brown. Thorax yellowish-brown, somewhat shiny; legs pale yellow, becoming darker on apical tarsal segments; halter knob brown; abdomen dull greyish-brown, including pleural membrane; terminalia pale brown. *Wing* evenly infuscate;  $R+R_1+R_{1+2}$  with macrotrichia along entire length, remaining veins bare;  $R_2$  situated towards apex of  $R_1$ ; bend in  $R_3$  gentle;  $R_3$  and  $R_{4+5}$  divergent toward wing margin; CuA lacking basal appendage. *Male abdominal sternite 1* comprising narrow band with broad-shaped posterior notch; sternite 2 reduced to slender, median sclerite, with broad, W-shaped, posterior apex; sternites 3–5 rectangular, sparsely setose; sternite 6 semicircular, anterior margin irregular; sternite 7 reduced to narrow, rectangular sclerite; sternite 8 membranous. *Male terminalia* (Figs 4–5): Epandrium broadly triangular from ventral aspect; posterior margin round, folded internally for third of length; lacking pointed posterolateral processes. Hypandrium broad, with shallow median notch; nearly one-half width of base of gonocoxite. Gonocoxite long, inner margin concave opposite gonocoxal plate; strongly tapered on apical fourth. Gonostylus long, gradually arched, tapering to blunt tip; apical half lacking setulae. Parameres fused to form long straight tube; apex strongly bent, bearing long setulae; extending beyond gonocoxites. Gonocoxal plate broad, with darkly sclerotized lateral margins, making it appear somewhat Y-shaped, secondarily fused to ventral surface of hypandrium; posterolateral corners produced into single pointed, curved process, surrounding paramere.

**Distribution.** This species is likely widespread throughout northern New South Wales and southeastern Queensland. This region of Australia is poorly collected for thaumaleids, which can often only be collected by hand. They are not attracted to colour pan traps and are extremely rare in flight intercept traps.

**Etymology.** The specific name is from the Latin *concavus* (hollowed or arched inward), referring to the distinctly concave inner margin of the gonocoxal lobes.

**Remarks.** This species somewhat resembles *A. tonnoiri* on the basis of the narrow infolded apex of the epandrium.



Figs 5–8. Male terminalia of *Austrothaumalea*: (5) *A. concava*, lateral view; (6) *A. queenslandensis*, ventral view; (7) *A. ramosa*, lateral view; (8) *A. ramosa*, ventral view. Scale bar = 0.1 mm. Abbreviations: *cerc*, cercus; *gcx pl*, gonocoxal plate; *gst*, gonostylus; *hypd*, hypandrium; *pm*, paramere.

### *Austrothaumalea denticulata* Theischinger

*Austrothaumalea denticulata* Theischinger, 1986: 301.

**Material examined.** New South Wales: 4♂♂, Blue Mtns NP, Blackheath, Grose Gorge, Govetts Ck, 1,25.xii.1993 (CNC); 3♂♂, 7♀♀, Blue Mtns NP, Grand Canyon, rainfor. stream, 25.xii.1993 (AMS); 8♂♂, Blue Mtns NP, Mt. Wilson, Waterfall Ck, 13.xii.1998 (ANIC); 1♂, Blue Mtns NP, Popes Glen, 31.x.1994 (AMS); 2♂♂, Blue Mtns NP, Valley of the Waters below Vera Falls, 320 m, 9.iv.1995 (ANIC); 7♂♂, 8♀♀ (incl. 2♂♂ reared from pupae), Sydney, Edgecliff, Trumper Pk, cliff seepage, 14.xi.1993 (CNC); 8♂♂, 6♀♀, same locality, 9.xi.1994 (AMS); 18♂♂, 5♀♀, Sydney, Kirribilli, roadcut seep, 5.xi.1993 (AMS, ANIC); 1♂, 1♀, Sydney, Mosman, Ashton Pk, stream, 31.x.1993 (AMS); 1♂, Wentworth Falls, Jamison Ck /seeps, 10.xi.1993 (ANIC); 8♂♂, 1♀, Wentworth Falls,

Valley of the Waters, cascading ck, 3.i., 23.x.1994, 9.iv.1995 (AMS).

**Queensland:** 1♂, Bunya Mtns NP, Paradise Falls, 8.x.2002 (ZFMK).  
**Victoria:** 4♂♂, 1♀, Mt. Buffalo NP, Eurobin Ck, 400 m, 30.xi.1994 (CNC); 1♂, Errinundra Plateau, Gap Rd, Result Ck Falls, 6–7.xii.1994 (AMS).

**Distribution.** The species ranges from Tasmania to south of Townsville, Queensland.

**Remarks.** The larva and pupa of this species were described by Sinclair (2000). The gonocoxal plate bears a crown of minute denticles along the ventral margin, directed anteriorly. These denticles are not shown in Theischinger (1986, fig. 31).

### *Austrothaumalea macalpinei* Theischinger

*Austrothaumalea macalpinei* Theischinger, 1986: 301.

**Material examined.** New South Wales: 1♂, Barrington Tops NP, Williams R, 480 m, subtrop. rainfor., 19.xii.1993 (CNC); 1♂, Chichester SF, trib of Williams R, 600 m, 19.xii.1993 (AMS).

**Distribution.** This species is confined to New South Wales.

**Remarks.** The gonocoxal plate bears two groups of minute denticles on either side of the mid-line along the ventral margin, directed anteriorly. These denticles are not shown in Theischinger (1986, fig. 39).

### *Austrothaumalea minnamurrae* Theischinger

*Austrothaumalea minnamurrae* Theischinger, 1986: 304.

**Material examined.** New South Wales: 1♂, Blue Mtns NP, Blackheath, Grose Gorge, Govetts Ck, 1.xii.1993 (CNC); 2♂♂, Blue Mtns NP, Valley of the Waters, cascading ck, 320 m, 3.i.1994, 9.iv.1995 (AMS); 1♂, 7 km E Robertson, Macquarie Pass NP, 23.xi.1993 (CNC). **Queensland:** 1♂, Bunya Mts NP, face of Little Falls, 8.ix.2002 (ZFMK). **Victoria:** 1♂, Mt. Buffalo NP, Eurobin Ck, 30.xi.1994 (AMS).

**Distribution.** This species ranges from southern Queensland to northern Victoria.

**Remarks.** The specimen from Woombye that was only tentatively included by Theischinger (1986) in *A. minnamurrae* is undoubtedly an undescribed species. Unfortunately, this specimen has been lost (see Acknowledgments).

The Bunya Mts specimen listed above possesses gonostyli with broad bases, similar to the Woombye species illustrated by Theischinger (1986, fig. 48). However all other key characters (e.g., shape of gonocoxal plate, lateral epandrial lobe) are very similar to that typical of *A. minnamurrae*.

### *Austrothaumalea queenslandensis* n.sp.

Fig. 6

**Type material.** HOLOTYPE ♂ “AUST: N.QLD: 400 m /Bellenden Ker N.P. /Kearneys Falls /23.iv.1994 /B.J. Sinclair”; “HOLOTYPE /*Austrothaumalea /queenslandensis /Sinclair [dissected]*” (AMS). PARATYPES: **Queensland:** 2♀♀, Mt. Windsor Tableland, 1000 m, creek, 16°26'S 145°12'E, 16.iv.1994, B.J. Sinclair (AMS).

**Recognition.** This species is similar in colouration to *A. zentae* but is distinguished by its shorter paramere and pair of apical teeth-like projections on the gonocoxal plate.

**Description.** *Wing length* 1.8–1.9 mm. *Coloration:* Head dull, dark brown. Thorax brownish-orange, somewhat shiny; legs pale yellow, becoming darker on apical tarsal segments; halter knob dark; abdomen dull greyish-brown, including pleural membrane; terminalia pale brown. *Wing* infuscate, darker along apical margin, especially at cell  $r_{1+2}$ ; wing base pale, especially along wing folding;  $R+R_1+R_{1+2}$  with macrotrichia along entire length, remaining veins bare;  $R_2$  situated towards apex of  $R_1$ ; bend in  $R_3$  gentle, not strongly defined;  $R_3$  and  $R_{4+5}$  divergent toward wing margin; CuA with short basal appendage. *Male abdominal sternites* 1 and 2 not examined; 3–6 rectangular, sparsely setose; sternite 7 reduced to narrow, rectangular sclerite; sternite 8 membranous. *Male terminalia* (Fig. 6): Epandrium broadly trapezoidal from ventral aspect;

posterior margin somewhat uneven with pair of small, round lateral knobs; lacking pointed posterolateral processes. Hypandrium broad, with deep median U-shaped cleft, nearly one-half width of base of gonostylus. Gonocoxite long, gradually tapering. Gonostylus long, curved strongly before mid-length; gradually tapering to blunt tip; apical half lacking setulae. Parameres fused to form long tube, slightly arched from lateral aspect; subequal in length to gonocoxites. Gonocoxal plate Y-shaped, secondarily fused to ventral surface of hypandrium; posterolateral corners with pair of tooth-like processes.

**Distribution.** This represents the most northerly described species of thaumaleid recorded in Australia, collected at an altitude of 400 m or above.

**Etymology.** Named for its restriction to the northern table-lands of Queensland.

**Remarks.** The small pointed, knob-like lateral projections on the gonocoxal plate are very similar to *A. macalpinei* (not shown in Theischinger [1986, fig. 39]).

### *Austrothaumalea ramosa* n.sp.

Figs 7–8

**Type material.** HOLOTYPE ♂ “AUST: NSW: Blue Mtns /N.P., Blackheath, seeps /below Govett's Leap /Lookout, 1.xii.1993/B.J. Sinclair”; “HOLOTYPE /*Austrothaumalea /ramosa /Sinclair*” (AMS). PARATYPES: **New South Wales:** 14♂♂, same data as holotype (AMS, ANIC, CNC); 1♂, 1♀, same locality as holotype, 18.vii.1994 (CNC); 8♂♂, 3♀♀, same locality as holotype, 17.x.2002 (CNC, ZFMK); 3♂♂, 1♀, Blue Mtns NP, Grand Canyon, 25.xii.1993, B.J. Sinclair (AMS); 1♂, Royal NP, roadcut seeps nr National Falls, 29.xii.1993, B.J. Sinclair (AMS); 2♂♂, Wentworth Falls, Jamison Ck/seeps, 10.xi.1993, B.J. Sinclair (AMS); 2♂♂, Wentworth Falls, Valley of the Waters, 3.i., 23.x.1994, B.J. Sinclair (AMS).

**Recognition.** This is a relatively large species with dark brown gonostyli, distinguished from all other described Australian species of *Austrothaumalea* by the pointed antler-like processes on the posterior corners of the gonocoxal plate.

**Description.** *Wing length* 2.6–3.0 mm. *Coloration:* Head dull, dark brown. Mesonotum dark brown and shiny, pleura brown, especially ventrally; coxae and femora pale brown, becoming darker on apical leg segments; halter knob dark; abdomen dull greyish-brown, including pleural membrane; terminalia shiny brown, becoming darker towards apex of epandrium and gonocoxites, gonostyli dark brown. *Wing* evenly darkly infuscate;  $R+R_1+R_{1+2}$  with macrotrichia along entire length, remaining veins bare;  $R_2$  situated towards apex of  $R_1$ ; bend in  $R_3$  gentle, not strongly defined;  $R_3$  and  $R_{4+5}$  divergent toward wing margin; CuA lacking basal appendage. *Male abdominal sternite* 1 comprising narrow band with broad-shaped posterior notch; sternite 2 reduced to slender, median sclerite, with broad, W-shaped, posterior apex; sternites 3–5 rectangular, sparsely setose; sternite 6 broadly triangular, anterior margin darkly pigmented; sternite 7 reduced to narrow, rectangular sclerite; sternite 8 reduced to pair of small round sclerites positioned ventral to base of gonocoxal plate. *Male terminalia* (Figs 7–8): Epandrium broadly triangular from ventral aspect; posterior margin with pair of small, round lobes; lacking pointed posterolateral processes. Hypandrium broad, nearly subequal to width of

base of gonocoxites. Gonocoxite long, gradually tapering. Gonostylus long, curved strongly before mid-length; gradually tapering to blunt tip; lacking setulae. Parameres fused to form long tube, slightly arched from lateral aspect; longer than gonocoxites. Gonocoxal plate secondarily fused to ventral surface of hypandrium; posterior corners expanded into 4 pointed antler-like prolongations.

**Distribution.** This species was collected in Blue Mountains National Park, west of Sydney. Adults were collected in seepages and streams bordered by subtropical rainforest. In addition, a single specimen was collected in Royal National Park, south of Sydney; unfortunately the habitat was severely burned during the bush fires of 1994.

**Etymology.** The specific name is from the Latin *ramosus* (branchy), in reference to the multi-branched or antler-like gonocoxal plate.

### *Austrothaumalea sinuosa* Theischinger

*Austrothaumalea sinuosa* Theischinger, 1986: 307.

**Material examined.** Victoria: 2♂, Errinundra Plateau, Gap Rd, Result Ck Falls, 6-7.xii.1994 (AMS); 1♀, Mt. Buffalo NP, Eurobin Ck, 400 m, 30.ix.1994 (AMS).

**Distribution.** This species is confined to southeastern New South Wales and northern Victoria.

**Remarks.** The gonocoxal plate bears a crown of minute denticles at the apex of each lateral arm. These denticles are not shown in Theischinger (1986, fig. 62).

### *Austrothaumalea spinosa* Theischinger

*Austrothaumalea spinosa* Theischinger, 1986: 307.

**Material examined.** New South Wales: 2♂, Blue Mtns NP, Blackheath, Govetts Leap, 17.x.2002 (ZFMK); 1♂, Blue Mtns NP, Valley of the Waters, below Vera Falls, 320 m, 9.iv.1995 (AMS); 1♂, Wentworth Falls, Jamison Ck /seeps, 10.xi.1993 (CNC); 2♂♂, Kosciusko NP, Thredbo, 1300 m, roadcut seeps, 28.xi.1994 (AMS). Victoria: 1♂, Otway NP, Maits Rest, temp. rainfor., ck, 4.xii.1994 (ANIC); 2♂♂, 2♀♀, Otway Ranges, Melba Gully SP, temp. rainfor., ck, 4.xii.1994 (AMS).

**Distribution.** This species is widespread in southeastern Australia from the Blue Mountains in New South Wales to Tasmania.

**Remarks.** There is some variation in the length of the apical spines on the gonocoxal plate, as well as differences in the length of the lateral epandrial process. More northern populations appear to have less pronounced spines on the gonocoxal plate.

### *Austrothaumalea theischingeri* n.sp.

Figs 9-10

**Type material.** HOLOTYPE ♂ “[AUST]: Blue Mtns. /NP, Blackheath, Govetts /Leap, seeps along track /12.xii.1998/B.J. Sinclair”; “HOLOTYPE /Austrothaumalea /theischingeri /Sinclair” (AMS).

**Recognition.** This species is similar to *A. uloola*, distinguishable by the form of the gonocoxal plate.

**Description.** Wing length 1.8 mm. *Coloration:* Head dull, dark brown. Mesonotum and pleura brown and somewhat shiny; legs paler than thorax; halter knob concolorous with legs; abdomen dark brown. Wing evenly infuscate; R+R<sub>1</sub>+R<sub>1+2</sub> with macrotrichia along entire length, remaining veins bare; R<sub>2</sub> situated towards apex of R<sub>1</sub>; bend in R<sub>3</sub> well defined; R<sub>3</sub> and R<sub>4+5</sub> divergent toward wing margin; CuA with short basal appendage. *Male abdominal sternite 1* narrow, spectacle-shaped; sternite 2 reduced to slender, median sclerite, with pair of small, posterolateral sclerites; sternites 3-6 rectangular, sparsely setose; sternite 7 trapezoidal-shaped, with several marginal setae; sternite 8 narrow, one-third length of sternite 7. *Male terminalia* (Figs 9-10): Epandrium broadly triangular from ventral aspect; posterior margin broad, folded internally, apex with pair of small rounded lobes; sharply pointed posterolateral processes present. Hypandrium broad, one-half width of base of gonostylus. Gonocoxite broad, somewhat narrower at apex. Gonostylus shorter than gonocoxites, gradually curved, tapered; clothed in setulae; apex partially flattened. Parameres fused to form short, laterally flattened, broad blade-like process arched lengthwise. Gonocoxal plate broad basally; median portion darkly pigmented as pair of ridges leading to 2 pairs of divergent digitiform processes; basally not fused to hypandrium.

**Distribution.** This species is known only from the holotype, the type locality of which is a densely wet, vast seepage area where at least seven species of thaumaleids are recorded.

**Etymology.** The specific name honours Günther Theischinger, who made the first careful study and revision of Australian thaumaleids.

**Remarks.** On the basis of the posterolateral epandrial processes, apex of epandrium and shape of the paramere, this species is most closely related to *A. uloola*.

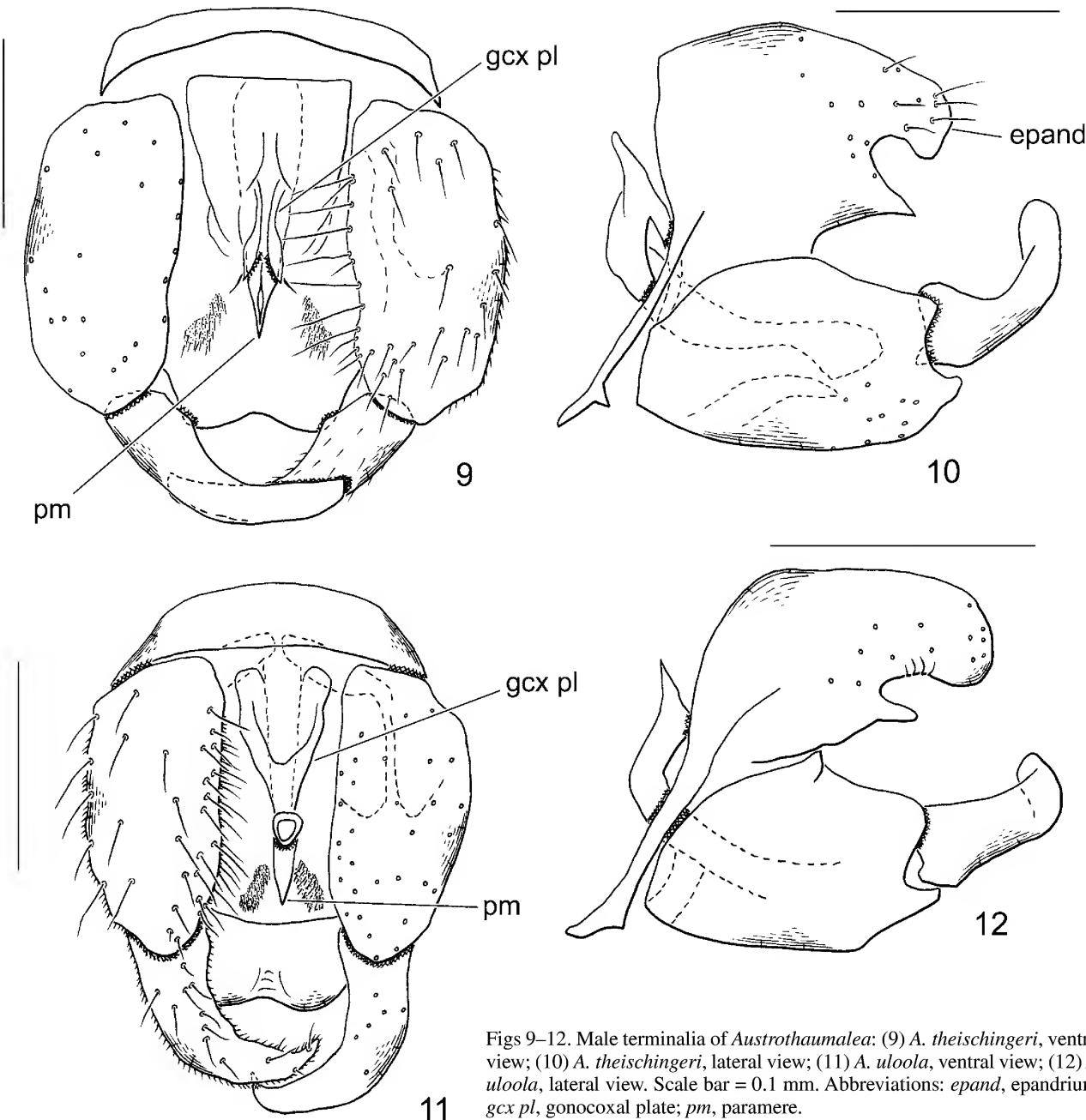
### *Austrothaumalea uloola* n.sp.

Figs 11-12

**Type material.** HOLOTYPE ♂ “AUST:NSW: Royal /N.P., Uloola Falls /17.xii.1993, seep behind /falls, B.J. Sinclair”; “HOLOTYPE /Austrothaumalea /uloola /Sinclair” (AMS). PARATYPES: New South Wales: 1♂, 2♀♀, same data as holotype (AMS); 2♂♂, 1♀, Royal NP, National Falls, 29.xii.1993, B.J. Sinclair (ANIC); 1♂, Royal NP, Uloola Falls, dry sclerophyll, 23.xi.1993, B.J. Sinclair (CNC).

**Recognition.** This species is distinguished by the folded apical margin of the epandrium and short gonocoxal plate with small circular apex.

**Description.** Wing length 1.8-2.0 mm. *Coloration:* Head dull, dark brown. Mesonotum and pleura dark brown and somewhat shiny; legs slightly paler than thorax; halter knob dark; abdomen dark brown; terminalia light brown. Wing evenly infuscate; R+R<sub>1</sub>+R<sub>1+2</sub> with macrotrichia along entire length, remaining veins bare; R<sub>2</sub> situated towards apex of R<sub>1</sub>; bend in R<sub>3</sub> gentle, not sharply defined; R<sub>3</sub> and R<sub>4+5</sub> divergent toward wing margin; CuA with short basal appendage. *Male abdominal sternite 1* narrow, spectacle-shaped; sternite 2 reduced to slender, median sclerite, with pair of small, posterolateral sclerites; sternites 3-6 rectangular, sparsely setose; sternite 7 trapezoidal-shaped, with 3 marginal setae;



Figs 9–12. Male terminalia of *Austrothaumalea*: (9) *A. theischingeri*, ventral view; (10) *A. theischingeri*, lateral view; (11) *A. uloola*, ventral view; (12) *A. uloola*, lateral view. Scale bar = 0.1 mm. Abbreviations: *epand*, epandrium; *gcx pl*, gonocoxal plate; *pm*, paramere.

sternite 8 narrow, one-third length of sternite 7. *Male terminalia* (Figs 11–12): Epandrium broadly triangular from ventral aspect; posterior margin broad, folded internally, apex with pair of small rounded lobes; pointed posterolateral processes present. Hypandrium broad, one-half width of base of gonostylus. Gonocoxite broad, somewhat narrower at apex. Gonostylus shorter than gonocoxites, gradually curved, tapered; clothed in setulae. Parameres fused to form short, laterally flattened, broad blade-like process arched lengthwise. Gonocoxal plate with pale central portion; apical half strongly tapered with circle-shaped apex; basally not fused to hypandrium.

**Distribution.** This species is recorded from Royal National Park, just south of Sydney. Adults were swept from seepages and wet vegetation hanging beneath or behind the falls. These falls are surrounded by dry sclerophyll forest.

**Etymology.** Named after the type locality, Uloola Falls.

**Remarks.** See under *A. theischingeri*.

#### *Austrothaumalea victoriae* Theischinger

*Austrothaumalea victoriae* Theischinger, 1986: 311.

**Material examined.** New South Wales: 2♂♂, Kosciusko NP, Kosciusko Rd, 1600 m, upper Pipers Ck, 7.xii.1994 (CNC). Victoria: 4♂♂, 1♀ (including pair in copula) Errinundra Plateau, Gap Rd, Result Ck Falls, 6–7.xii.1994 (AMS); 4♂♂, 9 km N Warburton, Cement Ck, 1–3.xii.1994 (ANIC); 2♂♂, Warburton Rd to Mt. Donna Buang, roadcut seep/stream, 3.xii.1994 (AMS).

**Remarks:** The specimens from Kosciusko bear a pair of short lateral epandrial processes on each side, rather than a single pointed process.

### *Austrothaumalea zentae* Theischinger

*Austrothaumalea zentae* Theischinger, 1986: 313.

**Material examined.** New South Wales: 4♂♂, 1♀, Barrington Tops NP, Williams R, 480 m, subtrop. rainfor., 19.xii.1993 (ANIC); 3♂♂, Blue Mtns NP, Blackheath, Govetts Leap, cliff edge trail 25.xii.1993, 12.xii.1998 (CNC); 1♂, Blue Mtns NP, Mt. Wilson, Waterfall Ck, 13.xii.1998 (AMS); 5♂♂, Blue Mtns NP, Valley of the Waters, below Vera Falls, 320 m, 3.i.1994, 9.iv.1995 (CNC); 1♂, 1♀, Border Ranges NP, Brindle Ck, Evans Falls, 1000 m, 25.i.1995 (AMS); 2♂♂, Dorrigo NP, Rosewood Ck, 23.i.1995 (AMS); 2♂♂, 1♀, 25 km E Dorrigo, Corambla Rd at Coopernook For. Rd, cascading ck, 2.iv.1995 (AMS); 1♂, 2♀♀, Kosciusko NP, Guthega Rd, 1400 m, Pipers Ck, 28–29.xi.1994 (AMS); 1♂, Kosciusko NP, Thredbo, 1300 m, roadcut seep, 28.xi.1994 (CNC); 6♂♂, Royal NP, Uloola Falls, 27.xi., 17.xii.1993 (CNC); 1♂, Wentworth Falls, Jamison Ck /seeps, 10.xi.1993 (ANIC). Queensland: Windsor Tablelands, 16°14'S 145°00'E, 1200 m, 16.iv.1994 (AMS). Tasmania: 2♂♂, Cradle Mtn NP, Overland/Dove Lk Trail, 900–1100 m, 21.ii.1994 (ANIC); 18♂♂, 6♀♀, Cradle Mtn NP, Pencil Pine Ck, 800 m, 20.ii.1994 (AMS); 3♂♂, Lyell Hwy. Franklin/Gordon Wild R NP, Nelson R, 20.ii.1994 (AMS); 6♂♂, 1♀, Rd C405, 12 km N of C401, 23.ii.1994 (AMS). Victoria: 1♂, Errinundra Plateau, Gap Rd, Result Ck Falls, 6–7.xii.1994 (AMS); 3♂♂, Mt. Buffalo NP, Eurobin Ck, 400 m, 30.xi.1994 (CNC); 3♂♂, 9 km N Warburton, Cement Ck, 1–3.xii.1994 (AMS).

**Distribution.** This species is the most widespread thaumaleid in Australia, ranging from Tasmania to northern Queensland.

**Remarks.** The gonocoxal plate bears a patch of minute denticles near the apex of each lateral arm. These denticles are not shown in Theischinger (1986, fig. 93).

### Genus *Niphta* Theischinger

*Niphta* Theischinger, 1986: 314.

The genus *Niphta* is characterized by a distinct ridge (supralar region) in front of the wing, microtrichia of first vein ( $R+R_1+R_{1+2}$ ) confined to base near humeral crossvein, crossvein closer to origin of  $R_3$  than to apex of  $R_{1+2}$ ,  $R_3$  with arch not strongly produced, basal appendage of CuA absent, gonocoxites broad, not much longer than wide and hypandrium narrow.

### *Niphta bickeli* Theischinger

*Niphta bickeli* Theischinger, 1986: 314.

**Material examined.** New South Wales: 4♂♂, Dorrigo NP, Wonga Walk, 700 m, Crystal Shower Falls, 2.iv.1995 (AMS); 1♂, 1♀, Dorrigo NP, Rosewood Ck, 23.i.1995 (CNC).

**Distribution.** This species is confined to Dorrigo National Park.

### *Niphta farecta* Theischinger

*Niphta farecta* Theischinger, 1986: 315.

**Material examined.** New South Wales: 8♂♂, 12♀♀, Blue Mts NP, Blackheath, Govetts Leap, seeps below lookout, 1.xii.1993, 12.xii.1998 (AMS, CNC); 4♂♂, Blue Mts NP, Valley of the Waters, cascading ck, 3.i.1994 (CNC); 3♂♂, 2♀♀, Blue Mts NP, Wentworth Falls, Jamison Ck, 3.i.1994 (ANIC); 1♀, Royal NP, Flat Rock Crossing, Saw Arm Ck, 6.iii.1994 (AMS); 3♂♂, 2♀♀, Royal NP, National Falls, 29.xii.1993 (AMS); 5♂♂, 8♀♀, Royal NP, Uloola Falls, 27.xi.1993, 17.xii.1993 (ANIC).

**Distribution.** This species is found just west and south of Sydney, New South Wales.

### Additional Queensland records of *Austrothaumalea*

Based on larvae (L) or undescribed females

- 1 Carnarvon NP, upper Carnarvon Ck, 11.x.2002 (L)
- 2 Blackdown Tablelands NP, Rainbow Falls, 2.v.1994 (L)
- 3 Eungella NP, Finch Hatton Gorge Araluen Falls, 1–200 m, Finch Hatton Ck, seepages, 30.iv.1994 (L, ♀)
- 4 Eungella NP, roadcut seepage, below Eungella, 500 m, 30.iv.1994 (L)
- 5 Paluma, Mt. Spec NP, Little Crystal Ck Falls, 300 m, seepage, 29.iv.1994 (L, ♀)
- 6 Crystal Cascades, 24 km SW Cairns, small cascading stream, iv.1994 (L)
- 7 Cape Tribulation (16°10'S 145°27'E), Little Cooper Ck, 75 m, 14.iv.1994 (♀)

### Discussion

#### Species-groups

The following species groups are tentatively proposed for the genus *Austrothaumalea*. There likely remain numerous undiscovered and undescribed species which may assist in the evaluation and interpretation of these groups and their supporting characters.

*Austrothaumalea appendiculata* group: This species group was originally proposed by McLellan (1988) and is characterized by an arrow shaped gonocoxal plate, strongly angled gonostylus with apical setulae and lateral foliate gills on the abdomen of the pupa. The *A. appendiculata* group is most closely related to the *A. neozealandica* group on the basis of pupal foliate setae, paired apical projections on the parameres and a pair of lateral processes on the posterior margin of the epandrium. The *A. appendiculata* group includes: *A. appendiculata* Tonnoir, *A. gibbsi* McLellan and *A. maxwelli* McLellan.

*Austrothaumalea barrydayi* group: This group is defined on the basis of an umbrella shaped gonocoxal plate and includes the following species: *A. barrydayi*, *A. bickeli*, *A. denticulata*, *A. similis* and *A. victoriae*.

*Austrothaumalea capricornis* group: The group is characterized by a shallowly to deeply forked gonocoxal plate with its outer margins more heavily sclerotized than medially. This group includes: *A. capricornis*, *A. chilensis* Edwards (from Chile), *Austrothaumalea* n.sp. (from New Caledonia, see Sinclair, in press), *A. commoni*, *A. concava*, *A. queenslandensis*, *A. ramosa*, *A. sinuosa*, *A. spinosa*, *A. zentae*; possibly *A. australis*, *A. macalpinei*, *A. simplex*, *A. tasmanica*, *A. tonnoiri* and perhaps *Oterere setipennis* (Edwards) (see under "Phylogenetic Affinities").

*Austrothaumalea fusca* group: This group is defined by the distinctive truncate gonocoxal plate (although this maybe the plesiomorphic condition), with its broad base. A subgroup is characterized by forked gonostyli. The *A. fusca*

group includes: *A. bifida*, *A. cervulus*, *A. fusca*, *A. uptoni* and possibly *A. apicalis* Edwards and *A. spatula* Schmid (both from Chile).

*Austrothaumalea minnamurrae* group: This group possesses slender epandrial processes and has T-shaped or arrow-head shaped gonocoxal plates. The shape of these structures are similar to the *A. appendiculata* group and consequently the *A. minnamurrae* group may possibly be the sister group to the New Zealand species of *Austrothaumalea*. The *A. minnamurrae* group includes *A. bicornis*, *A. minnamurrae* and *Austrothaumalea* sp. (Woombye).

*Austrothaumalea neozealandica* group: This species group was originally proposed by McLellan (1988) and is characterized by goblet-shaped or rounded lobes of the gonocoxal plate, and dorsal and lateral rows of foliate gills on the thorax and abdomen of the pupa. This group includes: *A. crosbyi* McLellan, *A. macfarlanei* McLellan, *A. ngaire* McLellan, *A. neozealandica* Tonnoir, *A. pala* McLellan, *A. walkerae* McLellan, and *A. zwicki* McLellan.

The following species are currently unplaced to species group: *A. theischingeri*, *A. uloola*.

### Phylogenetic affinities

*Oterere* is possibly paraphyletic in relation to *Austrothaumalea* and is characterized by the well-developed appendage on CuA, macrotrichia on R<sub>4+5</sub> and patterned wings. Unfortunately these features are not unique and the male terminalia of the two assigned species (*O. oliveri* McLellan, *O. setipennis*) do not share derived features. In addition, *A. tasmanica* also has R<sub>4+5</sub> bearing macrotrichia, several species have darkened wing tips, and the length of the appendage arising from CuA is variable in *Austrothaumalea* (long in *A. appendiculata* group).

Although relationships have been discussed and proposed by Sinclair & Stuckenber (1995) and Sinclair (2000), based on adult and immature characters, the phylogenetic relationships of the four Gondwanan genera of Thaumaleidae have not been formerly analyzed. Recent phylogenetic analyses attempted by this author have resulted in little support for major groupings. Greater knowledge of the South American fauna and immature stages in general would greatly assist these studies. In addition, the inclusion of molecular data sets would be a welcome addition to the search for a stable phylogeny of the Gondwanan genera and for the family Thaumaleidae.

### Faunal patterns

There are now 26 known species of *Austrothaumalea* in Australia. One species is confined to southwestern Australia (*A. australis*), seven species are known from Tasmania (four endemic), five species from Victoria, 18 species from New South Wales and seven species (three endemic to Northern Queensland) known from Queensland. *Austrothaumalea denticulata* and *A. zentae* are the most widespread species and the latter is the most northerly recorded thaumaleid in Australia. The great number of species known from New South Wales is both a reflection of the collecting effort and the diversity of aquatic habitats, where eight species are recorded from the Blue Mountains and seven species from Royal NP (of which four are not currently recorded from the Blue Mts.).

Nearly all species were collected in various rainforest types, ranging from cool wet temperate forests, gallery forests, and lowland and upland tropical rainforests. In the Sydney region, several species were collected from seepages in surrounding sclerophyll forests (e.g., *A. cervulus*, *A. denticulata*, *A. uloola*), however they occur also in other various types of rainforest localities.

**ACKNOWLEDGMENTS.** Günther Theischinger greatly encouraged the completion of this study. The Australian Museum provided space and facilities during early stages of this study, with special thanks to the Entomology section, especially Dan Bickel. Ian McLellan (Westport, NZ) kindly provided specimens of *A. appendiculata*. Scott Brooks (CNC) and two anonymous reviewers provided valuable comments on earlier drafts.

The following specimens from ANIC were unfortunately lost in July 2000 by the Postal Service on route from Australia to Fukuoka, Japan (former address of author) and consequently could not be examined directly: *A. nr minnamurrae* (from Woombye), *A. fusca* (holotype), *A. tonnoiri* (male paratype). The location or fate of the package could not be traced.

Collecting permits were obtained through the Australian Museum and Queensland Parks and Wildlife Service (Permit No. F1/000076/02/SAA).

### References

Colless, D.H., & D.K. McAlpine, 1991. Diptera (Flies) [Chapter] 39. In *The Insects of Australia*, vol. 2. 2nd edition, ed. I.D. Naumann, pp. 717–786. Carlton: Melbourne University Press.

McAlpine, J.F., 1981. Morphology and terminology—adults. [Chapter] 2. In *Manual of Nearctic Diptera*, vol. 1., ed. J.F. McAlpine *et al.*, pp. 9–63. Agriculture Canada Monograph 27: vi + 1–674.

McLellan, I.D., 1988. A revision of New Zealand Thaumaleidae (Diptera: Nematocera) with descriptions of new species and a new genus. *New Zealand Journal of Zoology* 15: 563–575.

Saigusa, T., 2006. Homology of wing venation of Diptera. A handout distributed at the 6th International Congress of Dipterology, Fukuoka, Japan. 26 pp.

Sinclair, B.J., 1992. A new species of *Trichothaumalea* (Diptera: Thaumaleidae) from eastern North America and discussion of male genitalic homologies. *The Canadian Entomologist* 124: 491–499.

Sinclair, B.J., 2000. Immature stages of Australian *Austrothaumalea* Tonnoir and *Niphta* Theischinger (Diptera: Thaumaleidae). *Australian Journal of Entomology* 39(3): 171–176. <http://dx.doi.org/10.1046/j.1440-6055.2000.00162.x>

Sinclair, B.J., in press. A new species of *Austrothaumalea* Tonnoir from New Caledonia (Diptera: Thaumaleidae). In *Zoologia Neocaledonica 6. Biodiversity studies in New Caledonia*, ed. P. Grandcolas. *Mémoires du Muséum d'histoire naturelle* 196.

Sinclair, B.J., & B.R. Stuckenber, 1995. Review of the Thaumaleidae (Diptera) of South Africa. *Annals of the Natal Museum* 36: 209–214.

Theischinger, G., 1986. Australian Thaumaleidae. *Records of the Australian Museum* 38(6): 291–317. <http://dx.doi.org/10.3853/j.0067-1975.38.1986.184>

Theischinger, G., 1988. *Austrothaumalea bickeli* spec. nov., a new thaumaleid from Australia (Insecta: Diptera: Thaumaleidae). *Stapfia* 17: 211–213.

# A New Subfamily of Spiders with Grate-shaped Tapeta from Australia and Papua New Guinea (Araneae: Stiphidiidae: Borrallinae)

MICHAEL R. GRAY\* AND HELEN M. SMITH

Australian Museum, 6 College Street, Sydney NSW 2010, Australia  
mike.gray@austmus.gov.au · helen.smith@austmus.gov.au

**ABSTRACT.** Five new genera of stiphidiid spiders are described from forest habitats in Australia and Papua New Guinea. They include *Couranga* n.gen. (*C. kioloa* n.sp., *C. diehappy* n.sp.), *Jamberoo* n.gen. (*J. johnnoblei* n.sp., *J. boydensis* n.sp., *J. actensis* n.sp. *J. australis* n.sp.) and *Elleguna* n.gen. (*E. major* n.sp., *E. minor* n.sp.) from eastern Australia; *Karriella* n.gen. (*K. treeensis* n.sp., *K. walpolensis* n.sp.) from southwestern Australia; *Asmea* n.gen. from Papua New Guinea (*A. akrikensis* n.sp., *A. hayllari* n.sp., *A. capella* n.sp., *A. mullerensis* n.sp.). A new subfamily, the Borrallinae, characterized by the presence of grate-shaped tapeta in all posterior eyes, is proposed. It includes the 5 genera described here plus *Therlinya* (Gray & Smith, 2002), *Borrala* and *Pillara* (Gray & Smith, 2004). The relationships of these putative stiphidiid genera are briefly discussed and the Kababininae is provisionally referred from the Amphinectidae to the Stiphidiidae. Observations on epigynal mutilation as a post-mating sperm protection mechanism are presented. Differences in visible tapetal structure between borraline spiders and *Stiphidion* are figured and discussed.

GRAY, MICHAEL R., & HELEN M. SMITH, 2008. A new subfamily of spiders with grate-shaped tapeta from Australia and Papua New Guinea (Araneae: Stiphidiidae: Borrallinae). *Records of the Australian Museum* 60(1): 13–44.

In two previous papers the stiphidioid genera *Therlinya*, *Borrala* and *Pillara*, all from eastern Australia, were described (Gray & Smith, 2002, 2004). The five additional genera described here resemble *Borrala* and *Pillara* in having a carapace with a longitudinally striped pattern (the “striped group” genera) and a profile in males that is typically highest at the fovea. *Therlinya* differs from the “striped” genera in having a carapace with a more or less arched profile in both sexes and no patterning. These genera are united by the presence of a grate-shaped tapetum in the PLE and PME, a tegular lobe on the male palpal bulb and wide female copulatory ducts. The eight genera included within this “grate-shaped tapetum group” are widely distributed along the coastal and highland forest regions of eastern Australia (except Tasmania), with extensions into southwestern Australia and the highlands of Papua New Guinea.

\* author for correspondence

All of these spiders are forest dwelling species with simple cribellate sheet webs in which they run hanging below the sheet. Several species exhibit what may be a unique form of paternity assurance involving female genital mutilation.

## Material and methods

Specimen examinations, measurements and drawings were made using a Wild M5 or Leica MZ 12 microscope with graticule and drawing attachment. The eye tapetal structures were examined in living and freshly killed spiders in 70% ethanol (routine characterization of the grate-shaped tapetum can be difficult because it is often obscured as a visible entity in preserved specimens [see techniques noted in Griswold, 1993]). Observations were made using a Leica MZ 12 microscope with two lateral cold light sources or a vertical

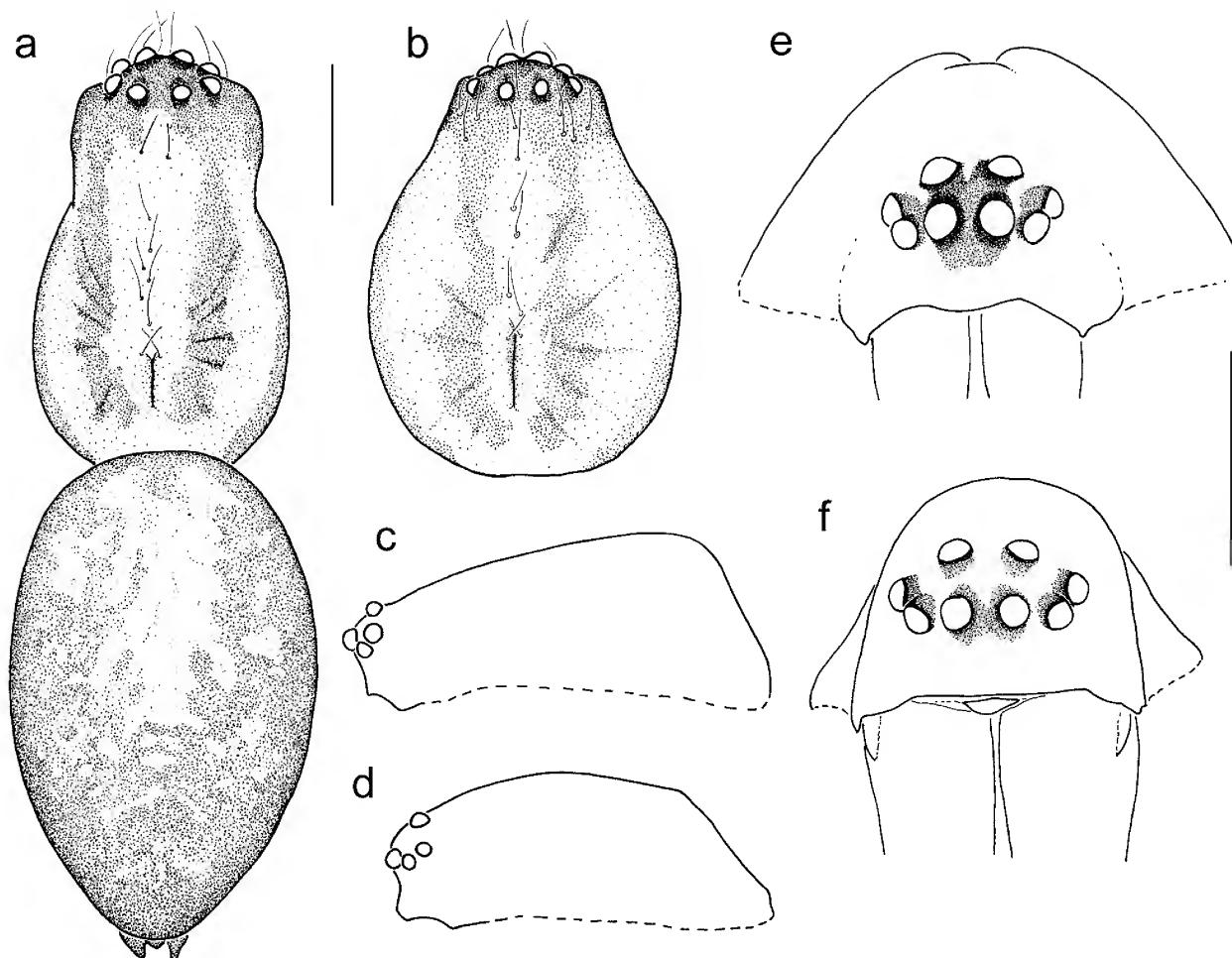


Fig. 1. *Couranga kioloa*: a,d,f, female: (a), body, dorsal; (d,f), female carapace: d, lateral; f, frontal showing chilum. (b,c,e), male carapace: b, dorsal; c, lateral; e, frontal. Scale lines 1.0 mm: left, a-d; right, e,f.

light source, and recorded with a Nikon Coolpix 990 digital camera. Epigynal preparations were cleared in 8% potassium hydroxide or lactic acid, before mounting in glycerol for microscopic examination. The left side male palp is illustrated and leg measurements are from the left side unless indicated. Spine counts are from left legs but the right side equivalent is given in parentheses if different. Specimen preparations for scanning electron microscopy were taken through 80–100% alcohol stages and air dried from 100% acetone. All measurements are given in millimetres. Carapace length for measured specimens is followed by a range value in parentheses.

**Abbreviations.** AER, anterior eye row; ALE, anterior lateral eyes; ALS, anterior lateral spinneret; AME, anterior median eyes; ASME, Australian Star Mountains Expedition to Papua New Guinea, 1965; BL, body length; CapW, caput width; CL, carapace length; Co, conductor; CST, canoe-shaped tapetum; CW, carapace width; Cyl, cylindrical spigot; CyF, cymbial flange; E, embolus; EGW, eye group width; fl, flange (epigynum); GST, grate-shaped tapetum; LL, labium length; LW, labium width; MA, median apophysis; mAP; minor ampullate spigot; MAP, major ampullate spigot; mMA, membranous MA; MOQ, median ocular quadrangle; mPLS, modified PLS spigot; NP, National Park; Pc, paracribellar spigot; PER, posterior eye row; PLE, posterior lateral eyes; PLS, posterior lateral spinneret; PME, posterior median eyes; PMS, posterior median spinneret; RTA, retrolateral tibial

apophysis; RDTA, retrolateral dorsal tibial apophysis; RVTA, retrolateral ventral tibial apophysis; SF, State Forest; SL, sternum length; sMA, sclerotized MA; SW, sternum width; TL, tegular lobe; TW, tegular window (opening bounded by the proximal embolus and the prolateral conductor margin); VCP, ventral conductor process.

**Repository institutions.** Specimens with the registration number prefix KS are deposited with the Australian Museum, Sydney. Other repositories are indicated by the following abbreviations: QM, Queensland Museum, Brisbane; SAM, South Australian Museum, Adelaide; WAM, Western Australian Museum, Perth

## Borralinae new subfamily

**Diagnosis.** Gracile cribellate spiders (Fig. 5b,c). All posterior eyes with grate-shaped tapeta; AME usually largest; feathery hairs present; trochanters deeply notched; male palpal tibia with VTA; cymbium with retrolateral flange; tegulum with basal to retrolateral tegular lobe; female copulatory ducts short, broad and flattened; PMS with fused paracribellar bases placed anteroectally.

The Borralinae differs from the Stiphidiinae by the presence of a GST in all posterior eyes, a palpal tegular lobe, a median apophysis and broad copulatory ducts. It differs similarly from

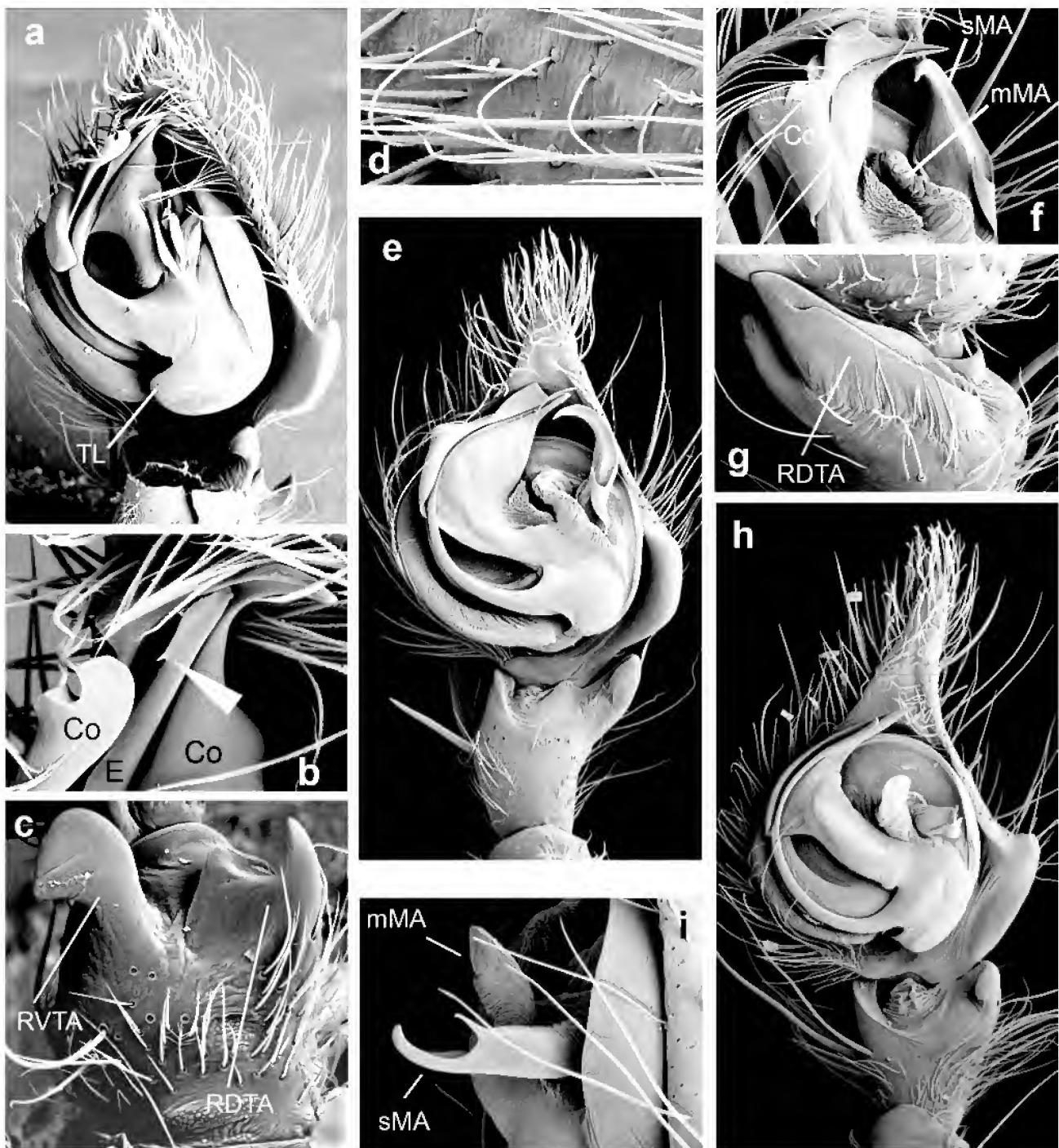


Fig. 2. Male palps. *a–d*, *Couranga kioloa* (KS69663): (a), cymbium and bulb, ventral; (b), distal conductor and embolus (barb on subapical embolus arrowed); (c), tibia, retrolateral; (d), trichobothria on cymbium. (e–g), *Karriella treenensis* (KS14702): e, tibia, cymbium and bulb, ventral; f, conductor and bipartite median apophysis, proventral; g, RDTA, dorsal. (h,i), *Jamberoo johnnoblei* (KS8503): h, tibia, cymbium and bulb, ventral; i, bipartite MA processes, retrolateral.

the Kababininae—but tapetal structure in latter is unknown—and additionally by the presence of a palpal RVTA. (See comments below on relationships of Kababininae).

### Description

**Cephalothorax and abdomen** (Figs 1a–f, 4a–d). Carapace profile usually highest at fovea in males but arched to flattish in females and in both sexes of *Therlinya*; carapace wider in males, caput more prominent in females; carapace

either patterned with a pair of dark grey longitudinal stripes stopping short of posterior carapace margin (“striped group” genera); or unpatterned with a cover of light grey-fawn hairs (*Therlinya*). Chilum entire. Chelicerae vertical, with prominent retrobasal boss; fang groove with 2 retromarginal and 3 promarginal teeth, basal promarginal tooth extended as a strong carina; numerous sensory hairs on the lower frontal paturon, with an enlarged hair at promarginal groove apex opposite the fang base; retrolateral jaw margin with a single apical sensory hair. Cheliceral/palpal femur “stridulatory”

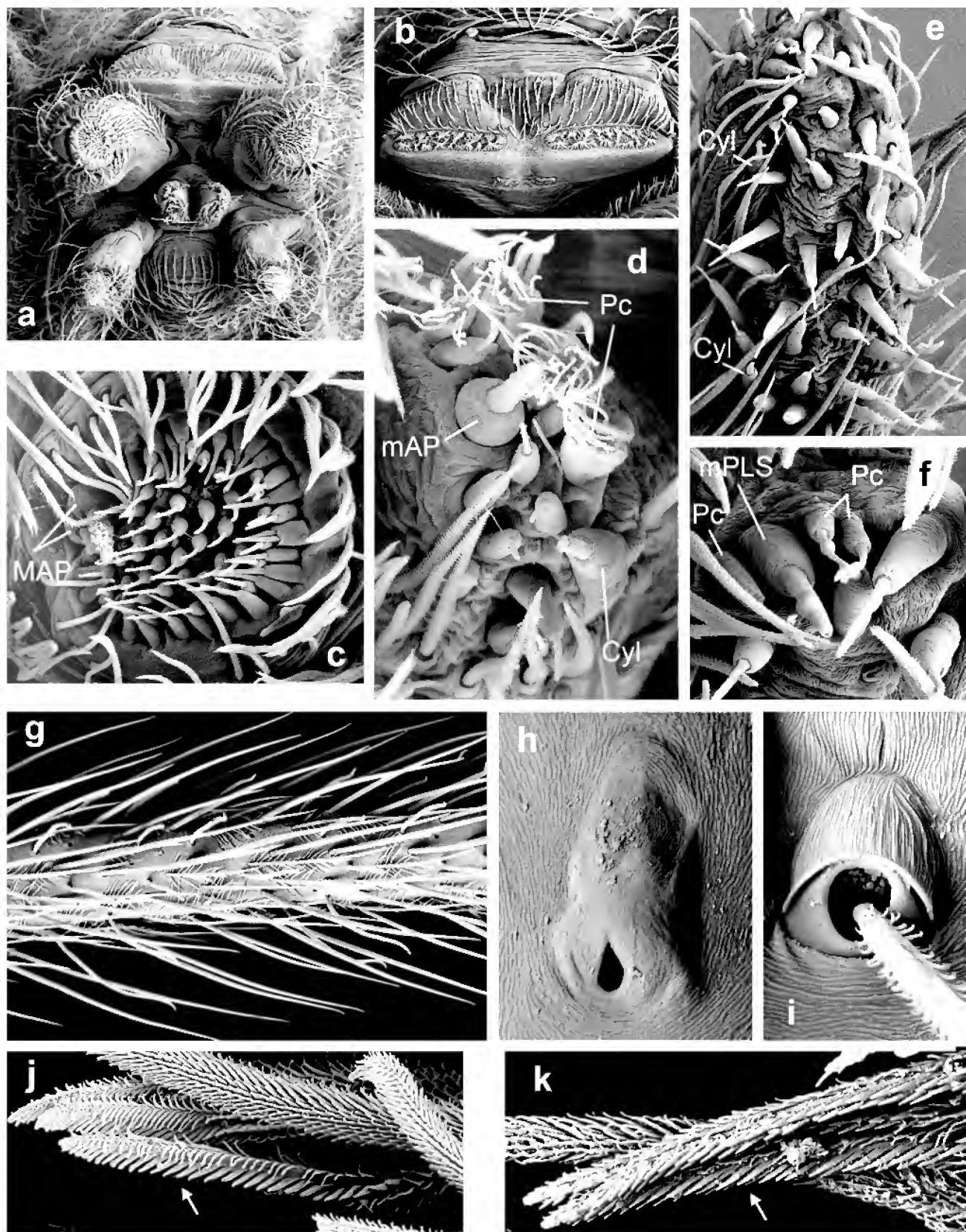


Fig. 3. *a–i*, *Jamberoo johnnoblei* (KS55724, female). (a–f), spinnerets: *a*, spinneret field and spiracle; *b*, cribellum; *c*, ALS (LHS); *d*, PMS (LHS); *e*, PLS (RHS); *f*, PLS, apical (RHS). (g–i), tarsal sensillae: *g*, hair types, ventral; *h*, tarsal organ; *i*, trichobothrium and cuticular sculpturing. (*j, k*), serrate accessory claw setae, tarsus I (arrows): *j*, *J. johnnoblei* (Mogo SF, NSW); *k*, *Stiphidion facetum* (KS53620).

setae present or absent (Fig. 15a–d). Maxillae longer than wide, lateral margins straight to weakly undulate, with a strong linear serrula. Labium slightly longer than wide, basally notched and narrowing to a weakly notched to truncate apex. Sternum cordate, posteriorly pointed to midway between coxae IV. Dorsal and ventral abdominal pattern typically as in Figs 1a, 4c,d.

**Eyes** (Figs 1a,b,e,f, 4f). Eyes in two rows; AME largest or subequal to PME; from above AER weakly recurved, PER weakly procurved; ALE with a canoe-shaped tapetum; PLE and PME with grate-shaped tapeta in the form of highly reflectile, broad, loose loops (Fig. 4g).

**Legs.** Slender; male legs longest with metatarsi I and II sometimes modified (slightly bowed and/or flattened). Femora and tibiae grey/brown banded. Trochanters deeply notched. 3–4 serrate accessory setae are placed lateral to the inferior tarsal claw (Fig. 3j); claw tufts and scopulae absent. Calamistrum linear, sub-proximal to central, 0.4–0.45× length of metatarsus and delimited at each end by a retrodorsal spine; weakly developed in males.

**Sensillae and cuticle** (Fig. 3g–i). Feathery hairs abundant on body and legs. Trichobothria longest distally, in single row on tarsi and metatarsi and 2 rows on tibia; present on female palpal tarsus and male cymbium (Fig. 2d); bothria collariform, proximal plate longitudinally ridged. Tarsal organ distal to trichobothria, capsulate with fine longitudinal ridging and pore keyhole to pyriform shaped. Cuticle sculpturing of “fingerprint” pattern (Fig. 3h,i).

**Male palp** (Figs 2a–i, 6a,b). Palpal cymbium with basal retrolateral flange. Tegular lobe basal to retrolateral, usually well developed (Fig. 2a) but sometimes reduced (Fig. 16a). Sperm duct clearly visible, S-shaped on basal or prolateral tegulum and partly associated with the TL (Fig. 6a). MA usually bipartite, if unipartite usually membranous; bipartite MA with medial process membranous (mMA), lateral process variably sclerotized (sMA) (Fig. 2f,i); MA occasionally reduced (e.g., *Pillara griswoldi* Gray and Smith). Conductor varies from T or modified T-shape to stalked broad falciform (prolateral limb of T may be reduced and retrolateral limb either spiniform or thickened); antero-prolateral conductor margin simple or with flange-like processes and folded to form a groove for the embolus (Fig. 2e,h). Embolus basally robust or slender, spiniform to rod shaped, curved and distal part embraced within the conductor groove (Fig. 2a,b,e,f,h). Tegular window prolateral to retrobasal, small to large (Fig. 6a). Tibia with two retrolateral apophyses (RVTA+RTA or RVTA+RDTA) and 2–3 strong prolateral to dorsal bristles or spines; patella with 1 or 2 long dorsal bristles (Figs 2c,g, 6a,b).

**Epigynum** (Figs 6c,d, 13d,g). Without lateral lobes or teeth; epigynal fossa paired or unpaired with anterolateral copulatory openings; copulatory ducts short, broad and flattened; paired spermathecae medium to large sized, globular to ovoid.

**Spinnerets** (Figs 3a–f, 4e). Cribellum bipartite, spinning fields widely separated in female (seam c. 0.3–0.4× a field width); seam and posterior plate margin strongly sclerotized, latter medially indented; in male, similar shape but narrower and non-functional. PLS slightly longer than ALS; PMS shortest. ALS: broad truncate cone, bases separated by about half a base width, apical segment very short with wide margins; PMS adjacent, spigot field longer than wide; PLS slender, bases separated by twice a base

width, apical segment tapering distally and almost as long as basal segment. Spigots (female): ALS: 2 MAP, 28–80 piriform; PMS: 1 mAP, 5–13 aciniform, multiple paracribellar on 2–6 fused bases placed anteroectally, 1 cylindrical; PLS: 11–35 aciniform, 1 modified PLS spigot, 3 free paracribellar, 2 cylindrical. Spigots (male): ALS: 1 MAP + 1 nubbin, piriform; PMS: 1 mAP + fused paracribellar nubbins, aciniform; PLS: aciniform + modified PLS spigot and paracribellar nubbins.

**Tracheal system.** Simple with 4 unbranched tubes confined to abdomen. Spiracle just anterior to cibellum and about 0.4× as wide as cibellum plate.

**Included genera.** *Therlinya* Gray & Smith, 2002; *Borralla* Gray & Smith, 2004; *Pillara* Gray & Smith, 2004; *Jamberoo* n.gen.; *Couranga* n.gen.; *Asmea* n.gen.; *Karriella* n.gen.; and *Elleguna* n.gen.

**Biology.** Borralline spiders are common in forest habitats in southern and eastern Australia and highland Papua New Guinea. They occupy simple, lacy, cribellate sheet webs associated with logs, rocks, hanging bark and stable soil banks (Fig. 5a). The webs are planar to arched sheets from 15 to 35 cm in extent with more or less irregularly scalloped margins depending on the position of guying points. The arched basal area tapers back into a short funnel-like entrance vestibule of stronger silk that leads into a shallow, sparsely silken retreat hole, crevice or cavity. The spiders run inverted under the sheet.

**Mating behaviour—epigynal mutilation.** In many spider species matings of males with mated females may be thwarted by the presence of epigynal mating plugs—either a hardened male secretion or detached parts of the male palp blocking the female copulatory ducts (Suhm *et al.*, 1996, Fromhage & Schneider, 2006). Secretory mating plugs are often seen in borraline spiders. However, another mechanism observed here that also may have a paternity assurance function is female genital mutilation. Several borraline species have unusual epigynal structures—prominent “knobs” (*Jamberoo* spp., Fig. 9c,d; *Karriella* spp., Fig. 13d,e; *Pillara griswoldi*, in Gray & Smith, 2004, fig. 11c,d) and thin marginal flanges (*Elleguna major* n.sp., Fig. 16c)—as well as the slender median epigynal septa seen in most *Jamberoo* spp., *E. minor* n.sp. (Fig. 17c) and *Asmea* spp. (Fig. 19c). Interestingly, these structures have been observed to be partly or completely broken away from the epigynum. The most notable mutilations were seen on the epigyna of *Jamberoo* spp. (Fig. 9e,f), *Karriella* spp. (Fig. 13f) and *Elleguna* spp. (Fig. 16d)—sometimes making them almost unrecognizable taxonomically. It seems possible that the damage is associated with movements of the male palp during mating—perhaps inflicted by the robust apophyses on the palpal tibia and bulb or the cymbial flange. In some cases the epigynum may be both mutilated and plugged (Figs 9e, 13f).

When intact, the epigynal structures noted above may play a significant role during mating as guides or anchor points for facilitating male palpal insertion. If this is so, their damage or loss could be expected to seriously compromise or negate subsequent male mating success.

Only one other example of possible paternity assurance via female genital mutilation is known to us. This is the

breakage of the elongate epigynal scapes present in some araneid genera, notably *Eriophora* Simon. Broken scapes have been observed in females of both Australian (pers. obs.) and American (Levi, 1970) species of *Eriophora*. Levi (1970) noted that the scape was missing in about 50% of *E. ravilla* and *E. fulginea* specimens examined.

### Notes on characters

**The grate-shaped tapetum in borraline spiders and *Stiphidion*** (see also notes in Gray & Smith, 2004). In recent analyses of entelegyne spider relationships (Griswold *et al.*, 2005) the genera *Stiphidion* Simon and *Pillara* are both scored as having eyes with a grate-shaped tapetum (GST). In *Pillara* and the other borraline spiders examined, a GST in the form of several wide reflectile loops (Fig. 4g) is present in both the PME and PLE, while the ALE has a canoe-shaped tapetum (CST). The GST has been observed in representatives of the five borraline genera for which fresh material was available—*Therlinya*, *Pillara*, *Borralla*, *Couranga* and *Jamberoo*—and it is presumed to be present in the remaining three genera. Homann (1971) records the presence of a GST in the PME and CST in the PLE and ALE of “*Stiphidium* spec.”. Examination of the eyes of *Stiphidion facetum* Simon shows a strongly reflecting CST in the ALE (Fig. 4h) but not in the PLE. In both the PLE and PME the tapetum appears as a moderately bright, flocculent, greyish-white layer. This layer may be either relatively uniform or differentiated, appearing either as a field of more or less bright fuzzy spots (Fig. 4i, PME) or as variable flocculent bands (Fig. 4j), the latter usually seen in the PLE. By contrast, the grate tapeta in many lycosoid and the borraline spider eyes consist of highly reflectile loops (Fig. 4g) that are readily visible using the observational methods described here. In their study of zoropsid spiders, Raven and Stumkat (2005) note that they were “unable to confirm that *Stiphidion* has a grate-shaped tapetum”. Taken together, the present evidence warrants the rejection of the presence of a GST in *Stiphidion*.

**Serrate accessory claw setae.** Although serrate setae are most strongly developed in the araneoid spiders (Griswold *et al.*, 2005), similar setae are also present in some stiphidiid spiders. Three to four of these “toothed” setae are placed at each side of the inferior tarsal claw in *Jamberoo johnnoblei* n.sp. (Fig. 3j) and *Borralla dorrigo* (fig. 2c,d in Gray & Smith, 2004). In these genera the “teeth” are in a single row but this may be doubled basally. Serrate setae are also present in *Stiphidion facetum* but the “teeth” are in a long double row (Fig. 3k). Griswold *et al.* (2005) score these setae as absent in *Pillara* and *Stiphidion*.

**Retrolateral tibial apophyses.** In *Therlinya*, *Borralla* and *Pillara* the decidedly more ventrally placed of the two retrolateral apophyses present was termed the RVTA, while the laterally placed apophysis was the RTA. However, in the genera described here the “RTA” is usually more dorsally placed and is termed the RDTA; whether all of these RDTA’s are RTA homologues is probable but uncertain. The term RVTA is retained for the more ventral apophysis, although in the new genera its position is often somewhat more retrolateral than in the three previously described genera. However, their homology is suggested by their basic structural similarity.

**Median apophysis.** An MA is present in all borraline genera. A single, membranous MA is present in *Therlinya*, *Pillara* and *Elleguna* (Fig. 17a). In the other genera the MA is a bipartite apophysis—the medial process is always membranous, while the lateral process is weakly to strongly sclerotized (Fig. 2f,i). The unipartite membranous MA may be homologous with the medial process of the bipartite MA.

**Legs.** Male metatarsi I and II are long and slender but in *Jamberoo*, *Couranga*, *Asmea*, *Karriella* and *Elleguna* they are also gently bowed and may be flattened as well.

**Stridulatory setae.** Modified setae are present on adjacent surfaces of the lateral paturon and the prolateral palpal femur in *Elleguna* and *Karriella* (Fig. 15a–d). Their position suggests a stridulatory function. In *Karriella treenensis* n.sp. the setae may be absent in some populations.

### Comments on relationships of the Borralinae

Results from a preliminary cladistic analysis of relationships with other Australian “amaurobioid” taxa group the eight borraline genera together as a strongly supported clade characterized by the presence of a GST in the PME and PLE, the tegular lobe, wide, flattened copulatory ducts and deep trochanteral notches. In this analysis the grate-shape tapetum has probably evolved at least twice—in *Baiami* Lehtinen and the Borrallinae (its status in *Stiphidion* was scored as unknown). Within the borraline clade, *Therlinya* is placed at the base of a cluster representing the seven “striped group” genera. The sister group of the Borrallinae is a rather heterogeneous clade comprising *Stiphidion*, *Baiami*, *Procambrigea* Forster and Wilton and *Wabua* Davies (the latter representing the subfamily Kababininae (Davies, 1999), currently placed in the family Amphinectidae). *Taurongia* Hogg (reviewed in Gray, 2005) is placed basal to these two clades. The “badumnine” genus *Phryganoporus* Simon (related to the amphinectids and currently in the Desidae) and the amphinectid *Tasmarubrius* Davies are placed successively basal to *Taurongia*.

This pattern of relationships resembles that consistently obtained by Davies (1999) and Davies & Lambkin (2000, 2001), in which the kababinine genera are always associated with *Stiphidion* and related genera but never with the Amphinectidae. *Kababina* Davies was originally placed in the Amphinectidae (Davies, 1995) and has been listed there since then (Platnick, 2007)—although Davies (1999) subsequently withdrew the subfamily from the Amphinectidae, she did not suggest an alternative family placement. Given all this, it is proposed that the Kababininae should be moved from the Amphinectidae to the Stiphidiidae. Although this move must be regarded as provisional, the family placement has greater taxonomic logic. The Stiphidiidae, as defined here, comprises the Stiphidiinae (*Stiphidion*, *Procambrigea* and *Baiami*), the Borrallinae and the Kababininae. The family remains heterogeneous and difficult to define, its main unifying features (mostly homoplasious) being the presence of feathery hairs; a long terminal PLS segment; a retroventral tibial apophysis (absent in Kababininae; ventral branch on RTA present: Davies, 1999); embolus usually spiniform; conductor a membranous plate (often partly sclerotized and of variable extent); and the absence of epigynal teeth or lobes. Six additional genera are listed with the Stiphidiidae in Platnick (2007) but we are not sufficiently familiar with them to comment on their placement.

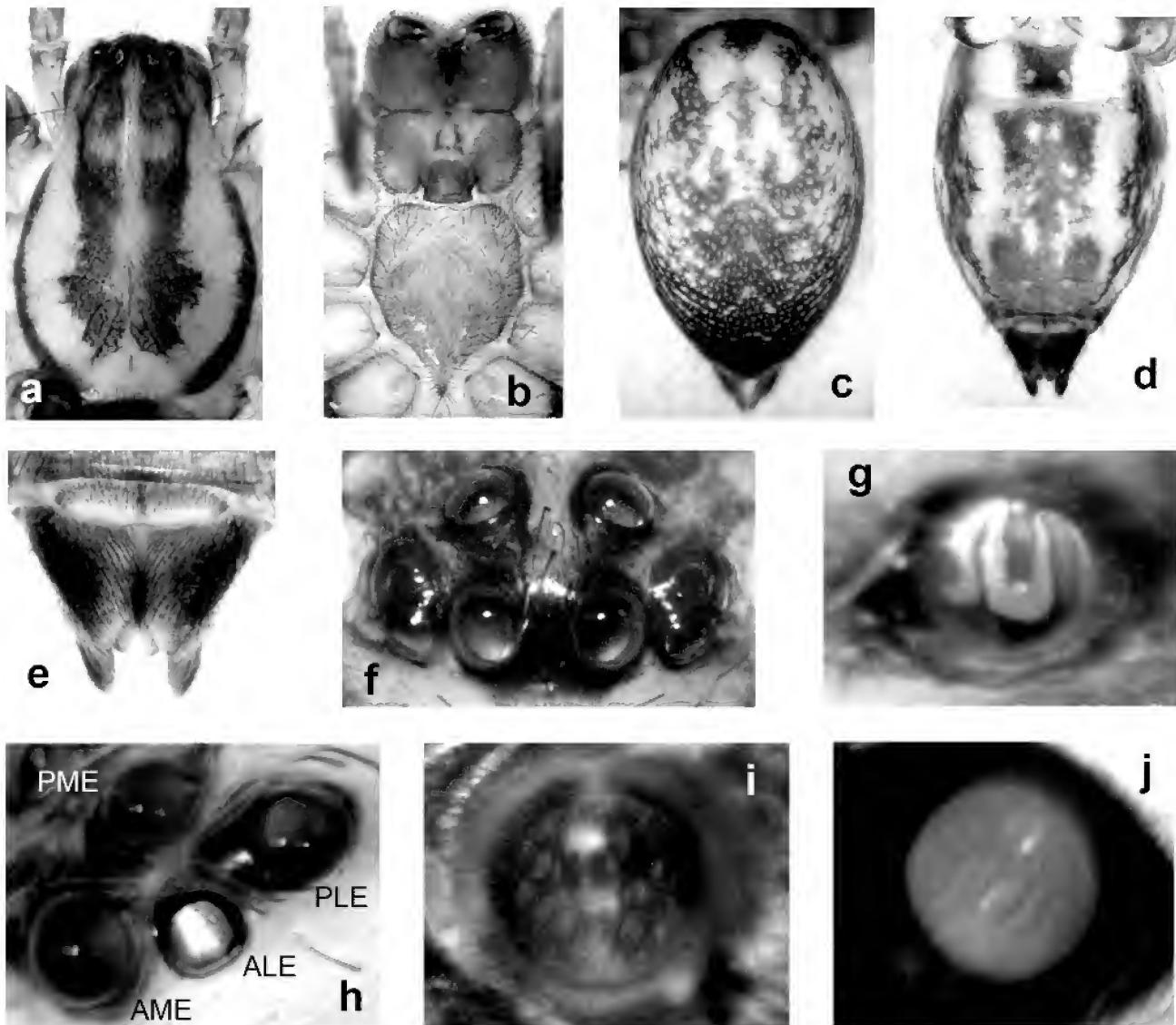


Fig. 4. *a–g*, *Jamberoo johnnoblei* (Royal National Park, NSW): (a–e), body, subadult male; (f,g), eyes, female. *a*, carapace; *b*, sternum and mouthparts; *c,d*, abdomen, dorsal and ventral; *e*, spinnerets, ventral; *f*, eye group, anterior; *g*, PME tapetum. (*h–j*), *Stiphidion facetum*, female: *h*, eyes, left side; *i*, PME tapetum (Hornsby, NSW); *j*, PLE tapetum (Jenolan, NSW).

While it emphasizes the robustness of the borraline clade, the cladistic analysis discussed above requires the addition of more representative taxa before it can be usefully presented. These include New Zealand groups such as *Orepukia* Forster and Wilton and related genera placed in the Agelenidae of Forster and Wilton (1973), some of which share marked genitalic similarities with the Borralinae. The structure of the eye tapeta in the *Orepukia* group is not recorded although *Neoramia* Forster and Wilton, a rather dissimilar NZ agelenid, lacks GST (Griswold *et al.*, 2005). The presence of the GST among the former “Amaurobioidea” (sensu Amaurobiidae + “fused paracribellar clade” of Griswold *et al.*, 1999) is currently limited to a few Australian taxa only—the Borralinae (in PLE and PME); *Baiami*, a stiphidiid genus (in PME); and *Barahna* Davies (in PME, pers. obs.), whose affinities are obscure (although it is currently listed in the Stiphidiidae—Platnick, 2007). The GST is more widely represented among the lycosoids and their relatives but homoplasy problems have placed the

phylogenetic value of the character in question (Griswold *et al.*, 2005). More information is needed to clarify the taxonomic distribution of the GST and the extent and significance of structural variation observed in grate-shaped and other types of tapeta.

The most recent analyses of entelegyne spider relationships presented by Griswold *et al.* (2005) unite the borraline genus *Pillara* with *Stiphidion* as the Stiphidiidae within the RTA clade. Two of the characters used require comment. Firstly, the MA is scored as absent in both genera—in fact, an MA is present in most *Pillara* spp. (Gray & Smith, 2004) but it is uniquely reduced in the exemplar species used (*P. griswoldi*). Secondly, the scoring of a GST as present in *Stiphidion* now seems unlikely, as discussed above. The two analyses presented place the stiphidiids either as part of a basal polyotomy or as the sister group of the Amaurobiidae (shared presence of RVTA). In both cases the stiphidiid clade is excluded from the fused paracribellar clade (cf. Griswold *et al.*, 1999).

## Key to genera of Borrallinae

1 Carapace without obvious patterning (with uniform light grey to fawn hair cover in life), profile arched, usually highest midcaput; eyes relatively small; MA unipartite; epigynum often with a large scape projecting over the epigastric groove (sometimes reduced or absent) (Gray & Smith, 2002, figs 1, 4) ..... *Therlinya*

— Carapace patterned with a pair of longitudinal grey-brown stripes, profile in males typically slopes up to fovea, weakly arched to flattish in female; eyes relatively larger; MA bi- or unipartite; epigynum without scape, fossa divided or undivided (the “striped group” genera) ..... 2

2 Males ..... 3

— Females ..... 9

3 RVTA with a long, thick stalk and “crochet-hook” like head; epigynal fossa undivided ..... 4

— RVTA with stalk short or absent; epigynal fossa divided or undivided ..... 5

4 RTA large, deeply bifurcate (Gray & Smith, 2004, fig. 11a) ..... *Pillara*

— RTA large, not bifurcate (Gray & Smith, 2004, fig. 4a) ..... *Borralla*

5 Conductor with a ventral process (VCP). MA unipartite (Figs 16a, 17a) ..... *Elleguna*

— Conductor without a ventral process, MA bi- or unipartite ..... 6

6 Conductor with a smoothly curved anterior margin, lacking processes ..... 7

— Conductor with anterior margin modified by flange-like processes ..... 8

7 Lateral MA process weakly sclerotized and entire (not bifurcate); RDTA long, keel-like (“keel” shorter and notched in *A. hayllari*) (Figs 18a,b–21a,b) ..... *Asmea*

— Lateral MA process strongly sclerotized and bifurcate spiniform; RDTA not keel-like (Figs 9a,b–12a,b) ..... *Jamberoo*

8 TL area indistinct; MA lateral process large, sclerotized and spiniform, with a flap-like basal spine (Figs 13a,b, 14a,b) ..... *Karriella*

— TL large; MA lateral process not as above (Figs 6a,b, 7a,b) ..... *Couranga*

9 Epigynum with a large, median, knob-like process placed anteriorly; fossa absent. (Gray & Smith, 2004, fig. 13c–e) ..... *Pillara* (part)

— Epigynum not as above; knob or knobs, if present, smaller and posteriorly placed; fossa present ..... 10

10 Fossa not divided (an indistinct median line may be present) ..... 11

— Fossa divided by a distinct median septum ..... 15

11 Fossa a small, in-sloped pit sometimes partially hooded by the anterior fossa margin; spermathecae posterior to fossa (overlapping in *P. karuah*) (Gray & Smith, 2004, figs 10c, 11c, 12c) ..... *Pillara* (part)

— Fossa larger, not as above; spermathecae posterior to or level with fossa ..... 12

12 Fossa elongate, open posteriorly; a pair of rounded knobs on the posterolateral epigynal plate (knobs may be damaged) (Figs 13d–f, 14d) ..... *Karriella*

— Fossa margin entire, knob-like processes absent ..... 13

13 Fossa large, floor with conjoined socket-like recesses posteriorly; lateral fossa margins flanged inwards over copulatory openings

- (flanges may be broken away) (Fig. 16c–d) ..... *Elleguna* (part)
- Epigynal characters not as above ..... 14
- 14 Spermathecae well separated (usually visible through cuticle); spermathecae mostly anterior to posterior fossa margin (Fig. 12c) ..... *Jamberoo* (part)
- Spermathecae touching medially, or almost so; spermathecae behind posterior fossa margin (Gray & Smith, 2004, figs 4c, 5c, 6c) ..... *Borralla*
- 15 Fossa median septum with a variably shaped posterior protuberance (rounded knob to narrow keel-like—may be damaged); spermathecae (if visible) well separated, mostly level with fossae (Figs 9c–f, 10c–e, 11c–d) ..... *Jamberoo* (part)
- Septum simple, without a posterior protuberance ..... 16
- 16 Fossae with shallow, lateral extensions (may be obscured by mating plugs); septum moderately wide; a pair of low mounds behind fossae (Figs 6c, 7c,d) ..... *Couranga*
- Epigynal characters not as above ..... 17
- 17 Fossae rounded, septum relatively short (may be broken); spermathecae adjacent (Fig. 17c–d) ..... *Elleguna* (part)
- Fossae strongly ovoid, septum longer; spermathecae separated (Figs 19c,f, 20c,f) ..... *Asmea*

**Note.** Damage to parts of the epigynum (epigynal mutilation—see comments above) or the presence of epigynal mating plugs may hinder the identification of some female specimens.

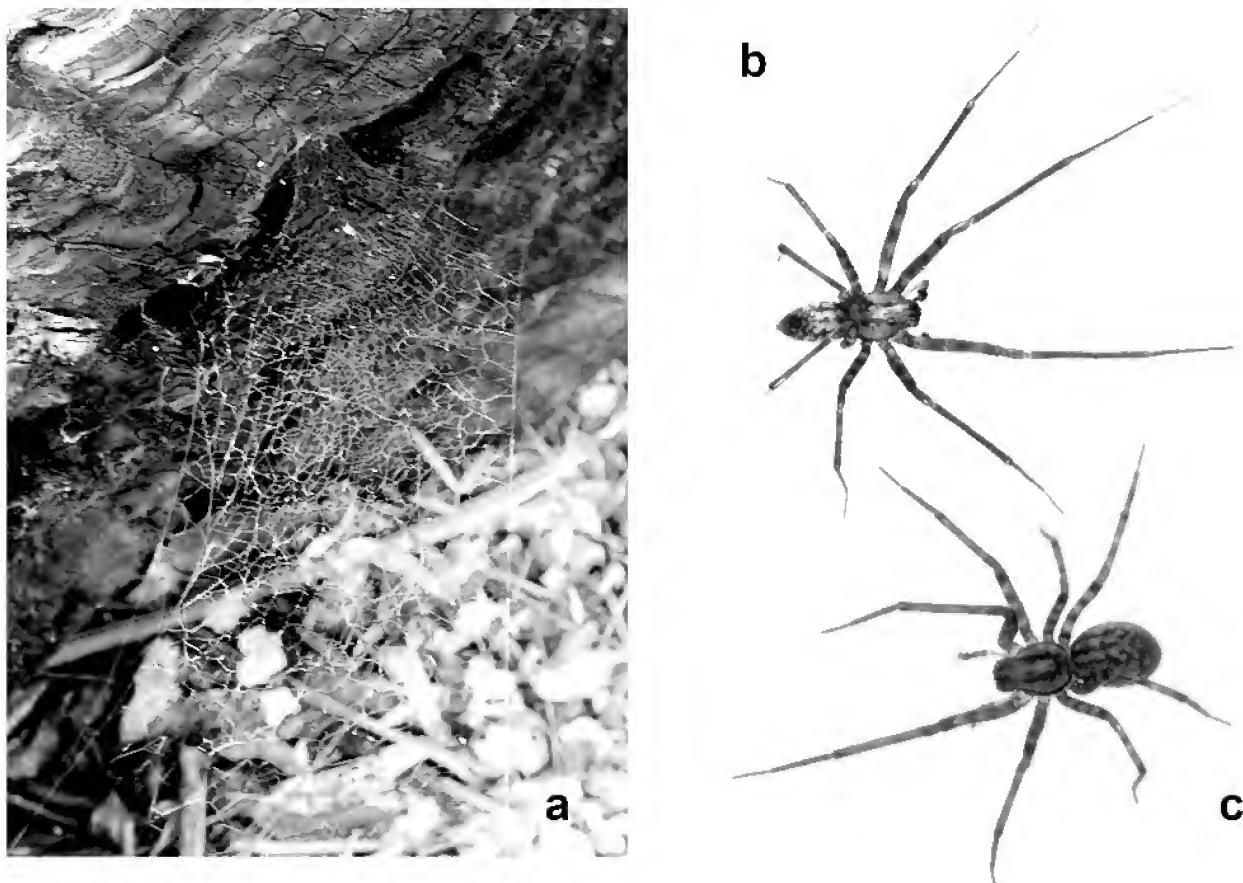


Fig. 5. *Jamberoo johnnoblei*: (a), sheet web on log, from above (Royal National Park, NSW). (b), male (Mount Keira, NSW); (c), female (Brown Mountain, NSW).

## *Couranga* n.gen.

**Type species.** *Couranga kioloa* n.sp.

**Etymology.** The generic name refers to a locality in Royal National Park, New South Wales, and is considered feminine in gender.

**Diagnosis.** Palpal cymbium with a relatively small but well-defined retrolateral flange, margin angled apically; bulb long with a pronounced basal TL; bipartite MA with membranous to weakly sclerotized processes; processes on anterior conductor margin. RVTA with definite stalk. Epigynum divided, fossae with shallow lateral extensions. Separated from other genera by the shallow lateral extensions of the epigynal fossae; additionally, from *Pillara*, *Borralla*, *Jamberoo* and *Asmea* by the complex conductor margin, from *Elleguna* by the absence of a ventral conductor process, and from *Karriella* by the divided epigynal fossa; separated from *Therlinya* by the striped carapace.

**Description.** Medium-sized, cribellate spiders (CL 2.24–3.47); with the characters of the subfamily Borrallinae. **Colour** (in alcohol) (Fig. 1a,b,e,f). Carapace amber-brown, eye region dark grey with eyes surrounded by black pigment; a pair of wide, variably pigmented dark grey stripes run mid-laterally back from the eye region to coalesce and terminate at or just behind the fovea; thoracic area with narrow, dark grey, marginal stripes. Mouthparts dark brown. Legs with distinct grey-brown bands on femora and tibiae; male metatarsi and tarsi unicolorous, orange brown to light grey brown. Dorsal abdomen patterned in greyish-brown and unpigmented patches with a narrow, grey mid-dorsal anterior stripe, sometimes indistinct, and 4–5 chevrons posteriorly; lateral abdomen with a mosaic of darker and lighter patches; venter grey-brown with several more or less paired pale patches centrally and a pair of pale stripes laterally.

**Carapace.** Profile highest at fovea in male; in female gently arched, often flattish from mid-caput to fovea (Fig. 1c,d). Foveal slit moderately long and deep, curving down onto concave rear slope of carapace. Clypeus about 2× width of an AME. Cheliceral/palpal stridulatory organ absent. Eyes eight, relatively large (cf. *Therlinya*); gratae-shaped tapeta in posterior eyes; EGW 0.70–0.80× width of caput; AME largest or subequal to PME: AME>PME>PLE>ALE. MOQ almost square, slightly narrower anteriorly.

**Legs.** 1423. Male metatarsus II with middle to distal part weakly bowed (dorsally concave) and dorsoventrally flattened; less evident on metatarsus I. Spines: Leg tibiae with 0–2 ventral apical spines; metatarsi with distal whorl of 5 spines. Representative leg spination (*C. kioloa*): Male (KS74065)—I: femur d122, p011; tibia d0010, v221, p111, r1010; metatarsus d202, v201, p0101, r0101; II: femur d122, p0111; tibia d0010, v221, p111, r1010; metatarsus d202, v201, p0101, r0101; III: femur d122, p0111; patella d001; tibia d1010, v122, p1010, r0110; metatarsus d202, v221, p0101, r0101; IV: femur d112, p001; tibia d1010, v112, p0101, r01010; metatarsus d212, v221, p0101, r001. Female (KS74066)—I: femur d112, p011; tibia d001(small), v220, p111, r1010; metatarsus d002, v221, p0101, r0101; II: femur d122, p0111; tibia d0010, v220, p111, r1010; metatarsus d102, v221, p0101, r0101; III: femur d122,

p0101; patella d101; tibia d1010, v011(111), p0101, r01010; metatarsus d202, v2021, p0101, r0101; IV: femur d112, p001; patella d001; tibia d1010, v112, p0101, r01010; metatarsus d2012, v221, p0101, r001. Three tarsal claws: superior 9–10 teeth, inferior 2–3 teeth. Female palpal tarsi spinose; palpal claw with 11–12 teeth. Trichobothria in single row of 5–6 on both tarsi and metatarsi.

**Male palp** (Figs 2a–d, 6a,b). Cymbium with a coniform apex with 3 bristle-like spines; retrolateral flange well defined, with apical margin offset at c. 90° to cymbium. Bulb much longer than wide. Tegulum with a large, basal TL, strongly offset from base of embolus. Sperm duct visible on the basal tegulum as a thick, upright S-shaped loop. T-shaped conductor with anterior margin modified (rather than uniformly curved)—prolateral thickened with an apically notched process arising centrally, and a retrolateral “crested” spine-like conductor apex curving ventrally (Figs 2a,b, 6a). Embolus arising prolaterally from a wide base, curving through less than 180° as a gradually tapering rod with a single sub-distal barb and a blunt apex resting within the sub-apical conductor groove (Fig. 2b). Tegular window prolateral, of small to moderate size. MA bipartite: medial process small, membranous; lateral process a thin, membranous or weakly sclerotized lamina (Figs 6a,b, 7a,b). Tibia about as long as wide, with 3 strong prolateral to dorsal bristles and two distal apophyses: RVTA with a short to moderate length stalk and an ovoid, blunt, beak-like head; RDTA a thick hooked or spine-like process. Patella about as long as wide with a dorsal bristle.

**Epigynum** (Fig. 6c,d). Paired fossae separated by a moderately wide septum; fossae shallow, extended laterally and narrowed centrally (sometimes almost “dumbbell-shaped”—Fig. 7c). Posterior to fossae a pair of low cuticular mounds overlie the spermathecae (visible through cuticle) (Fig. 6c). Copulatory ducts open anterolaterally adjacent to septum (fossae and openings sometimes obscured by mating plug). Internal genitalia simple, with a pair of very short, broad copulatory ducts curving back to enter the spermathecae, where they equal its width; spermathecae oblong-globose and adjacent, placed immediately behind the fossa.

**Spinnerets.** Cribellar plate with each field c. 3.0× as wide as long and separated by a wide seam (about 0.5× a field width). Spigots (female, KS62178): ALS: 2 MAP spigots, mesal, adjacent, unequal; c. 35 piriform spigots; PMS: 1 mAP with 2–3 fused paracribellar bases (each with c. 6 to 8 spigots) grouped anteroectally around it; 5 aciniform spigots (1 anterior, rest distributed); 1 cylindrical spigot, ectal; PLS: c. 11 aciniform spigots, distributed; 1 modified PLS spigot, subapical, flanked by 3 paracribellar spigots, all free; 2 cylindrical spigots (1 basal, 1 central).

**Included species.** *Couranga kioloa* n.sp., *C. diehappy* n.sp.

**Remarks.** These spiders are distributed from southeastern NSW to southeastern Queensland; the two species overlap widely in the central–northeastern region of NSW. Modification of the anterior conductor margin is shared with *Karriella* and *Elleguna*, although the structural details differ, especially in the latter genus. Epigynal plugs, which may fill the fossae, are frequently found in both species.

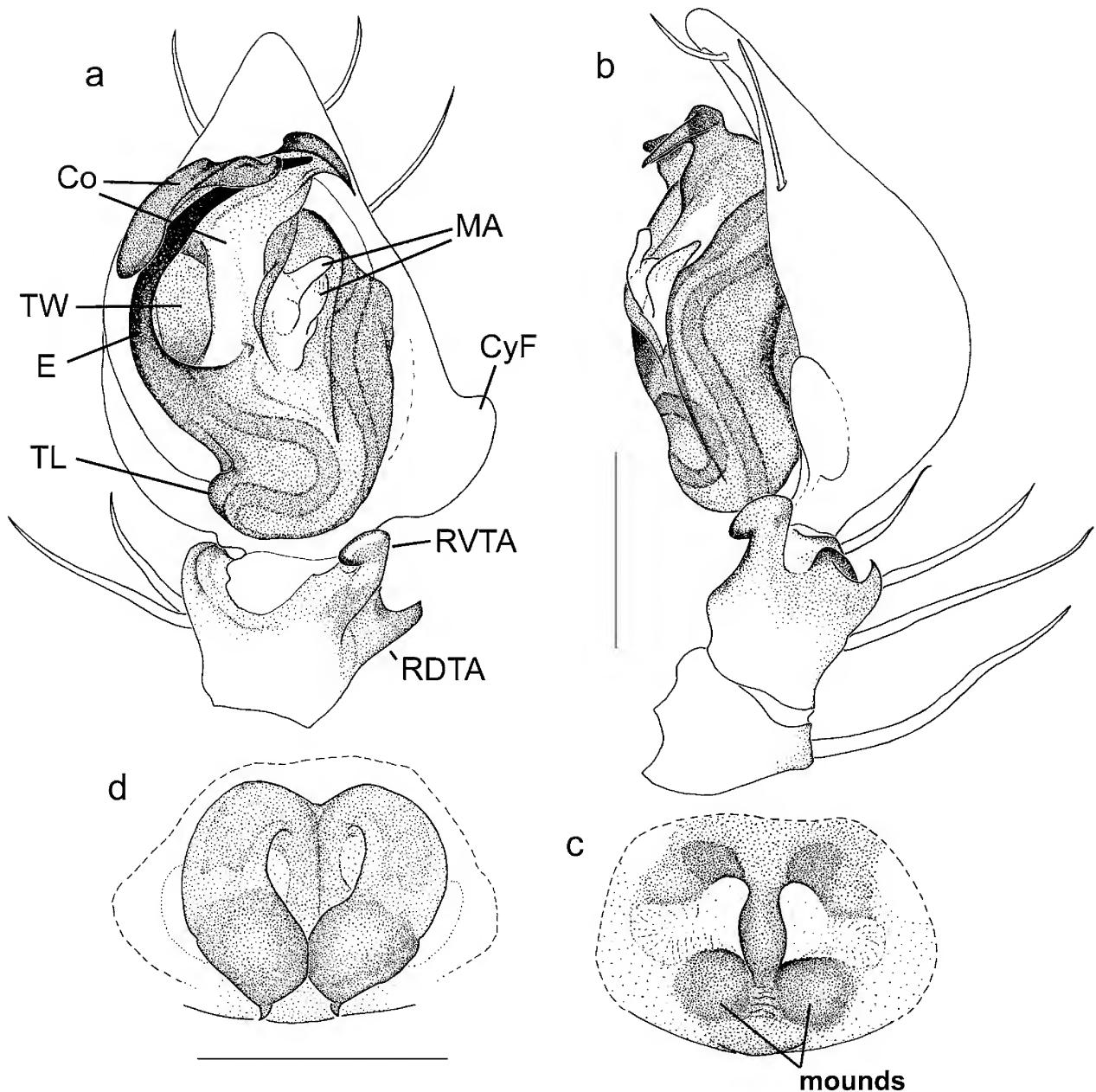


Fig. 6. *Couranga kioloa*. (a, b), male palp (holotype): a, ventral; b, retrolateral. (c, d), epigynum: c, ventral (KS74064); d, dorsal—internal genitalia (KS69664). Scale lines 0.5 mm: upper, a, b; lower, c, d.

### *Couranga kioloa* n.sp.

Figs 1a–f, 2a–d, 6a–d, 8b

**Type material. New South Wales:** HOLOTYPE: ♂, KS74065, 1.5 km W of Kiah on Towamba Rd, 37°09'S 149°50'E, 15 Apr. 1978, M.R. Gray, small, angled sheet webs projecting from shallow retreats in soil bank and guyed to vegetation. PARATYPES: ♀, KS74066, data as for holotype; ♀, KS74064, data as for holotype, sheet webs in mossy bank along road, female matured in captivity; ♂ KS69662, ♀, KS86843, Mogo SF, 10 km S of Batemans Bay on Princes Highway, 35°48'S 150°08'E, 18 Apr. 1978, M.R. Gray, in webs under rock, open forest; ♂ KS34571, ♀, KS86842, Smiths Lake turn-off, Myall Lakes, 32°23'S 152°30'E, 27 Apr. 1974, M.R. Gray.

**Other material. New South Wales:** ♀, KS1931, Kioloa SF, Forest Drive, 35°37'S 150°16'E, 2 Nov. 1978, C. Horseman, in litter, with egg sac 4 mm diameter in silk purse retreat 10 mm diameter, eggs pale orange; ♂, KS5546, Benandarah SF, 8 km N of Batemans Bay, 35°40'S 150°14'E, 4–30 Oct. 1979, C. Horseman; ♀, KS6470, Royal National Park, Sydney, 34°08'S 151°04'E, 16 Jan. 1981, M. Gray, dry sclerophyll, under log in small messy

sheet web; ♀, KS34572, Darkes Forest, 34°14'S 150°55'E, 8 Sep. 1972, R.E. Mascord; ♂, ♀, KS34573, 13 km N of Bega on Bega–Bermagui back road, 36°25'S 150°04'E, 18 May 1973, M.R. Gray, under dry log in dry area open forest, tangled web in crevice; ♂, ♀, KS34574, 11 miles S of Kempsey on Joes Cutting turn-off, 31°15'S 152°49'E, 27 Apr. 1974, M.R. Gray, in bank in suspended sheet web; ♀, KS34576, Maria SF picnic area near Kempsey, 31°11'S 152°50'E, 23 Apr. 1974, M.R. Gray, with egg sac; ♂, KS41267, Bundjalung NP, on ridge between Big Marsh & Esk River, 29°17'35"S 153°16'40"E, 4 Feb.–9 Apr. 1993, M. Gray & G. Cassis, NE NSW NPWS Survey, pit trap; ♂, KS50515, Booti Booti NP, 32°16'S 152°31'E, 17 July 1996, L. Wilkie, Bitou Pilot Study, sand dunes, pit trap; ♂, KS50516, data as KS50515, 15 July 1996; ♀, KS60719, Booti Booti NP, 32°14'44"S 152°32'33"E, 9 Oct. 1997, L. Wilkie; ♂, KS68360, data as KS60719, 12 Nov. 1996, sand dunes, pit trap; ♂, KS62463, Booti Booti NP, 32°14'28"S 152°32'50"E, 9 Oct. 1997, L. Wilkie, sand dunes, pit trap; 2 ♀ ♀, KS62178, Macquarie Pass, Macquarie Pass NP, 34°34'S 150°39'E, 12 Sep. 1999, H. Smith, in web on rotting log; ♂, KS62928, Booderee NP, southern headland of Jervis Bay, 35°08'49"S 150°45'05"E, 20–25 Aug. 1999, L. Gibson, pit trap; ♂, KS63013, Mount Kembla, Sydney Catchment Authority Reserve, 34°26'33"S 150°44'24"E, 6–10 Dec. 1998, L. Gibson,

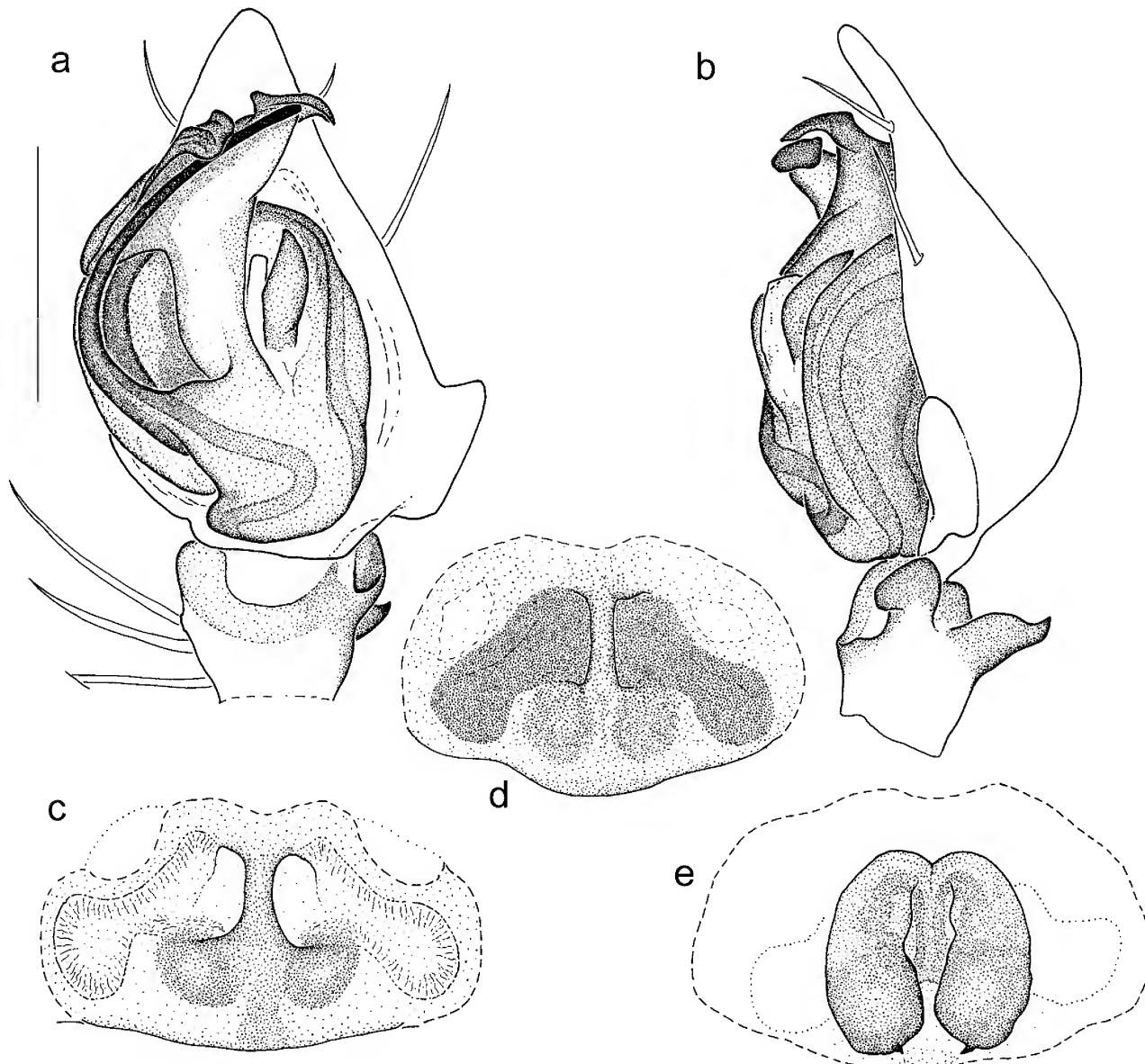


Fig. 7. *Couranga diehappy*. (a,b), male palp (holotype): a, ventral; b, retrolateral. (c–e), epigynum: c, ventral (KS75360); d, ventral, with plug (KS58105); e, dorsal—internal genitalia (KS75366). Scale line 0.5 mm.

pit trap; ♂, KS63067, data as KS63013, 21–25 June 1999; ♂, KS63171, Royal NP, Sir Bertram Stevens Drive c. 0.3 km E Artillery Hill, 34°04'55"S 151°03'40"E, 6–20 Dec. 1999, Gray, Milledge & Smith, STH SYD Hotspots, site 8, pit trap; ♂, KS63242, Woronora Dam Catchment, Princes Hwy c. 0.1 km NW Southern Freeway Overpass, 34°11'31"S 150°57'58"E, 8–22 Dec. 1999, Gray, Milledge & Smith STH SYD Hotspots, site 11, pit trap; 2 ♂♂, KS69658, KS69663, 2 ♀♀, KS69664–5, Bodalla SF, 8 km NNW Central Tilba near Mt Dromedary turn-off, 36°16'S 150°03"E, 17 Apr. 1978, M.R. Gray, on bank; ♀, KS69660, Bodalla Forest Park, 9 km S of Bodalla on Princes Highway, 36°10'S 150°06"E, 18 Apr. 1978, M.R. Gray, rotten log, in dry disturbed open forest; ♀, KS69659, Currawan SF, 35°37'S 150°05"E, 18 Apr. 1978, M.R. Gray; ♀, KS69661, Mogo SF, 10 km S of Batemans Bay on Princes Highway, 35°48'S 150°08"E, 18 Apr. 1978, M.R. Gray, in webs under rock, open forest, dry and burnt fairly recently; ♂, KS74067, Mt Warning Camp Ground, Wallaby Track, 28°24'S 153°16"E, 18 May 1998, H. Smith, retreat in leaf litter, lines to rotting log, collected as juvenile, matured 27 May 1998; ♂, KS74068, data as KS74067, matured late July 1998; ♂, KS74071, Kiwarra State Forest, S of Taree, 31°58'S 152°26"E, Oct. 1976, K.D. Fairy, NSW Forestry Survey material, BPK 76OC J/24. **Queensland:** ♀, S64468 (QM), nr. Girraween NP, 28°51'S 151°57"E, R. Raven, 7 Apr. 1974; ♀, S64467 (QM), Gt Dividing Range nr Teviot Brook, 27°27'S 152°33"E, 25 Dec. 1974, R. Raven, 2,700 ft, sclerophyll.

**Diagnosis.** Differs from *C. diehappy* as follows: Palpal RVTA with stalk of moderate length; RDTA a thick, distally hooked process; MA processes small, subequal in size. Epigynal septum widened at middle; paired fossae with short lateral extensions.

### Description

**Male (holotype).** BL 5.93, CL 2.95 (range 2.78–3.47), CW 2.22, CapW 1.09, EGW 0.83, LL 0.40, LW 0.40, SL 1.45, SW 1.24. Legs: 1423 (I: 11.82; II: 9.42; III: 8.40; IV: 10.98); ratio tibia I length:CW = 1:0.73. Male palp (Fig. 6a,b). RVTA stalk longer than in *C. diehappy*; RDTA thick, curved and hook-like distally. Distal loop of sperm duct U-shaped with parallel limbs. Embolus a basally wide, curved rod with a subapical barb (Fig. 2b). MA processes subequal, lateral process usually membranous.

**Female** (KS74066). BL 6.40, CL 2.95 (range 2.24–3.47), CW 1.85, CapW 1.35, EGW 0.90, LL 0.41, LW 0.43, SL 1.41, SW 1.23. Legs: 1423 (I: 9.89; II: 8.13; III: 7.16; IV: 9.25); ratio tibia I length:CW = 1:0.73. Epigynum (Fig. 6c,d). Median septum widest at middle. Paired fossae with relatively short lateral extensions (cf. *C. diehappy*). Internal genitalia with very short copulatory ducts, about as wide as spermathecae.

**Distribution.** South-eastern New South Wales to the Border Ranges area of NSW and southeast Queensland.

**Etymology.** The specific name refers to Kioloa State Forest, a collection site.

### *Couranga diehappy* n.sp.

Figs 7a–e, 8b

**Type material. New South Wales:** HOLOTYPE: ♂, KS61689, Dichappy SF, Horseshoe Rd, 0.5 km N of Scotchman Peak, 30°28'30"S 152°39'43"E, 11–24 Nov. 1999, M. Gray, G. Milledge & H. Smith, NE NSW Hotspots, site 18, pit trap. PARATYPES: ♀, KS75360, Scotchman SF, Horseshoe Rd & Kirklands Rd junction, 30°28'08"S 152°44'00"E, 23 Nov. 2001, G. Milledge & H. Smith, stop 4, sheet web in earth bank; ♂, KS74070, Maroota SF, 33°31'S 150°59"E, 5 Oct. 1979, G.A. Webb, NSW State Forests, pit trap; ♀, KS79583, Hornsby, Waitara Creek, 33°42'52"S 151°05'22"E, 1 Sep. 2002, H. Smith & G. Milledge, sheet web with retreat into earth bank; ♂, KS89868, data as for KS79583, Autumn 2004 (matured Aug. 2004), H.M. Smith. **Queensland:** ♂, ♀, S55468 (QM), N. Stradbroke Island Enterprise, 27°33'S 153°28"E, 90 m, 8 Jan. 2002, QM party, Blackbutt #1, day; ♂, S64481 (QM), 0.5 km NW Mt Beecher, 23°55'S 151°11"E, 15 Dec. 1999–20 Mar. 2000, G. Monteith, vine scrub, intercept trap 20 m; ♂, S64487 (QM), 0.5 km S of Fairlies Knob, 25°31'S 152°17"E, 21 Jul.–20 Oct. 2000, Cook, Wright, Vanderduys, vine scrub, pitfall, 300 m; 2 ♀ ♀, S56406 (QM), Fraser Island, 25°15'S 153°10"E, 11–14 Feb. 2000, B. Baehr & R. Raven.

**Other material. New South Wales:** ♂, SAM BS1550, Kunderang Cave KB4, 30°55'S 152°10"E, 11 Dec. 1966, P. Hudson; 3 ♀ ♀, KS34569, Willoughby, 33°48'S 151°12"E, 2 Aug. 1969, G.S. Hunt, under rotting logs, fairly moist; 3 ♀ ♀, KS34575, 6 miles W of Kempsey on Sherwood Rd, 31°04'S 152°44"E, 24 Apr. 1974, M.R. Gray, sheet webs in moist bank; ♀, KS34577, Camden Razorback, 34°07'S 150°38"E, 1 May 1969, M.R. Gray; ♀, KS34578, Ku-ring-gai Chase NP, 33°39'S 151°13"E, 8 Sep. 1972, M.R. Gray, under rock in silk case with egg sac; ♀, KS34579, Ku-ring-gai Chase NP Bobbin Head, 33°39'S 151°09"E, 10 May 1974, M.R. Gray, in logs; 3 ♀ ♀, KS34580, data as KS34579, 10 Apr. 1974, in logs, sheet web, moist forest nr creek; ♀, KS34581, 18 km E of Woodford, 33°44'S 150°33"E, 17 Apr. 1974, M.R. Gray, low woodland-heath, in logs; ♀, KS34583, Mt Wilson, Cathedral of Ferns, 33°30'S 150°23"E, 26 June 1974, M.R. Gray & C. Horseman; ♀, KS58105, Ku-ring-gai Chase NP, near Mt Colah, 33°40'S 151°07"E, 2 July 2000, G. Milledge & H. Smith; ♀, KS68262, Hornsby, Waitara Creek, 33°42'52"S 151°05'22"E, 25 Sep. 2000, G. Milledge, under rock, with egg sac; 2 ♀ ♀, KS69657, KS79576, data as KS68262, 21 Sep. 2000, H. Smith & G. Milledge; 5 ♀ ♀, KS78346, data as KS68262, 28 Oct. 2001, H. Smith; 3 ♀ ♀, KS79584–6, data as KS68262, 20 July 2002, G. Milledge, under rocks; ♂, KS74069, Maroota SF, 33°31'S 150°59"E, 7 Nov. 1979, G.A. Webb, NSW State Forests, B/40, pit trap; 4 ♀ ♀, KS75357, KS75359, KS79579–80, Scotchman SF, junction of Horseshoe Rd & Little Boggy Track, 30°26'08"S 152°48'55"E, 23 Nov. 2001, G. Milledge & H. Smith, stop 3, sheet webs in earth bank; 4 ♀ ♀, KS75366–7, KS79577–8, Mt Kaputar NP, 0.8 km W of Coryah Gap Carpark, 30°16'44"S 150°07'40"E, 13 Nov. 2001, M. Gray, G. Milledge & H. Smith, stop 20, sheet webs in earth bank; ♀, KS75368, Mt Kaputar NP, 1.6 km W of Coryah Gap Carpark, 30°16'13"S 150°07'11"E, 13 Nov. 2001, M. Gray, G. Milledge & H. Smith, stop 19, sheet webs in earth bank. **Queensland:** ♂, KS69420, Brisbane Forest Park, 27°25'04"S 152°49'48"E, 11–16 Jan. 1998, N. Power, malaise trap 3; ♂, KS69497, data as KS69420, 27 Sep–2 Oct. 1998, trap 2; ♂, KS69467, Bribie Island, 27°03'30"S 153°11'32"E, 9–14 Aug. 1998, N. Power, heathland/acacia regrowth, malaise trap 1; ♀, KS69654, Blackdown

Tableland NP, campsite area, 23°47'49"S 149°04'14"E, 8 May 2000, G. Milledge & H. Smith, ex rotting tree stump; ♂, S55720 (QM), N Stradbroke Island Enterprise, 27°34'S 153°27"E, 60 m, 9 Jan. 2002, QM party, Blackbutt #2, day, hand coll.; ♀, S55737 (QM), N Stradbroke Island Enterprise, 27°36'S 153°27"E, 70 m, 10 Jan. 2002, QM party, Scribbly Gum #3, day, hand coll.; ♀, S55539 (QM), as S55737, J. Burwell, berlesate, sifted litter; ♀, S55748 (QM), N Stradbroke Island Enterprise, 27°33'S 153°28"E, 90 m, 8 Jan. 2002, QM party, Blackbutt #1, day, hand coll.; 2 ♀ ♀, S64486 (QM), foot of Blackbutt Ra. nr Benarkin, 26°53'S 152°08"E, 25 Aug. 1979, R. Raven, under rock, sheet web; ♀, S64484 (QM), Mt Coottha, SEQ, 1 Jan. 1974, R. Raven; ♂ S64483 (QM), Conondale Ra., Kenilworth, 26°35'S 152°43"E, 1 Sep. 1974, R. Raven, rainforest; ♂, S64482 (QM), 1 km S Blue Mtn, 21°37'S 148°58"E, 22 Mar.–31 May 2000, Monteith & Cook, pitfall, 680 m, wet sclerophyll; ♂, S64485 (QM), top of Blackbutt Ra., 26°52'S 152°11"E, 24 Oct.–24 Nov. 1995, G. Monteith, intercept trap, 400 m; ♂, S64480 (QM), Gold Ck Reservoir, Brookfield, 27°27'S 152°49"E, 1 Oct. 1980, V. Davies, R. Raven, closed forest; ♂, S64479 (QM), Searys Scrub, Cooloola, 26°02'S 153°03"E, 3–7 Feb. 1976, R. Raven, V. Davies, pit traps; 2 ♂ ♂, 9 ♀ ♀, S64474 (QM), Searys Scrub, Cooloola, SEQ, 4 Feb. 1976, R. Raven, V. Davies, males from pit traps, females from horizontal sheet web back into log; ♀, S64476 (QM), Freshwater Road, Cooloola, 26°00'S 153°08"E, 26 Dec. 1974–28 Mar. 1975, G.B. & S.R. Monteith, pitfall trap; ♀, S64478 (QM), Wild Horse Mtn, Beerwah, 26°56'S 153°00"E, 10 Sep. 1975, R. Raven; ♀, S64466 (QM), Conondale Ra, ca 26°40'S 152°40"E, 31 Aug. 1974, R. Raven, sheet web & ventral retreat in bank; ♀, S64470 (QM), Conondale Ra, 31 Aug. 1974, R. Raven, sheet web with funnel (ventral) as retreat; ♀, S64469 (QM), Teviot Stream, Bonah, 27°59"S 152°41"E, 3 Oct. 1973, V. Davies, under lattice sheet web on bank; ♀, S64471 (QM), Rochedale SF, 27°36'S 153°09"E, 23 Nov. 1979, R. Raven, V. Davies, web under log; ♀, S64477 (QM), Rochedale SF, SEQ, 20 Sep. 1979, R. Raven, V. Davies, sheet web under log; ♀, S64472 (QM), Paul Lenz Plain at Bunya Mts NP, 26°50'S 151°33"E, 7 Nov. 1994, pitfalls, tussock grassland; ♀, S64473 (QM), Teewah Ck, Cooloola Rainforest, 26°05'S 153°02"E, 14 Sep. 1973, R. Raven, sheet web with retreat under log, spider using lower surface of sheet; ♂, S64475 (QM), Ravensbourne, 27°20'S 152°09"E, 16 Feb. 1974, R. Raven.

**Diagnosis.** Differs from *C. kioloa* as follows: palpal RVTA with short stalk; RDTA a thick, undulate spine-like process; MA with lateral process largest & weakly sclerotized. Epigynal septum not widened at middle; paired fossae with lateral extensions often longer than in *C. kioloa* (“dumbbell-shaped”).

### Description

**Male (holotype).** BL 5.83, CL 2.50 (male range 2.25–3.17), CW 1.92, CapW 0.94, EGW 0.71, LL 0.31, LW 0.39, SL 1.22, SW 1.06. Legs: 1423 (I: 11.08; II: 8.67; III: 7.50; IV: 9.75); ratio tibia I length:CW = 1:0.66. Male palp (Fig. 7a,b). RVTA like *C. kioloa* but with shorter, wider stalk; RDTA a thick, undulate, spine-like process. Distal loop of sperm duct V-shaped with limbs. Embolus longer and thinner than in *C. kioloa*, and conductor apex less strongly “crested”. MA lateral process usually weakly sclerotized and larger than in *C. kioloa*.

**Female** (KS75360). BL 6.08, CL 2.58 (female range 2.42–3.25), CW 1.67, CapW 1.14, EGW 0.75, LL 0.35, LW 0.41, SL 1.31, SW 1.10. Legs: 1423 (I: 9.10; II: 7.27; III: 6.41; IV: 8.24); ratio tibia I length:CW = 1:0.72. Epigynum (Fig. 7c–e). Median septum relatively narrower than in *C. kioloa* and not obviously widened at middle. Paired fossae often with longer lateral extensions and more obviously narrowed centrally (more or less “dumbbell-shaped”, cf. *C. kioloa*). Internal genitalia similar to *C. kioloa*.

**Distribution.** Central eastern New South Wales to southeast Queensland.

**Etymology.** The species name is taken from the type locality.

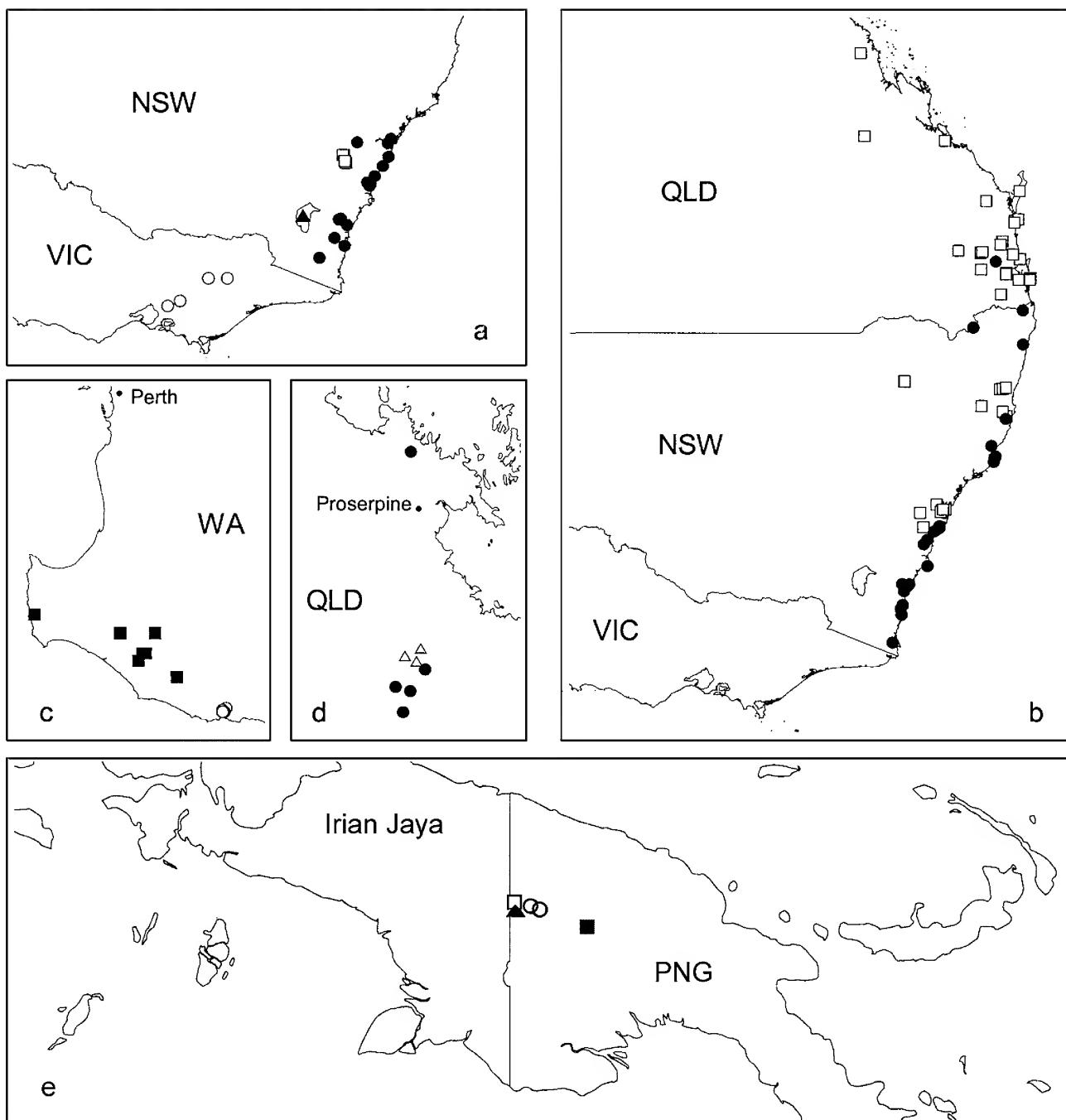


Fig. 8. Distribution records: (a), *Jamberoo* spp.: *J. johnnoblei*, ●; *J. boydensis*, □; *J. actensis*, ▲; *J. australis*, ○. (b), *Couranga* spp.: *C. kioloa*, ●; *C. diehappy*, □. (c), *Karriella* spp.: *K. treenensis*, ■; *K. walpolensis*, ○. (d), *Elleguna* spp.: *E. major*, △; *E. minor*, ●. (e), *Asmea* spp.: *A. akrikensis*, ▲; *A. hayllari*, ○; *A. capella*, □; *A. mullerensis*, ■.

### *Jamberoo* n.gen.

**Type species.** *Jamberoo johnnoblei* n.sp.

**Etymology.** The generic name is taken from the Jamberoo region of New South Wales where these spiders are abundant. It is considered masculine in gender.

**Diagnosis.** Palpal cymbium with large retrolateral flange; bulb with tegular lobe basal to retrobasal; MA large, bipartite—with membranous and bifurcate sclerotized processes; RVTA short, blunt, beak-like; RDTA short,

concave. Epigynal fossa divided by median septum with a knob to keel-like process posteriorly (except *J. australis*); spermathecae separated, placed at mid-posterior half of fossa. Separated from *Pillara* and *Borralla* by the presence of a short RVTA, from *Couranga*, *Karriella* and *Elleguna* by the simple, unmodified T-shaped conductor structure, and from *Asmea* by the well sclerotized, bifurcate lateral MA process.

**Description.** Medium-sized, cribellate spiders (CL 2.65–4.24). Similar to *Couranga* in general characters. Legs. 1243 or 1423. Male metatarsi I, II bowed (but

not flattened), more noticeable in larger specimens. Representative leg spination (*J. johnnoblei*): Male (KS84009)—I: femur d1202, p01110; tibia d0010, v2020, p1110, r1010; metatarsus d0001, v2021, p0101, r1102. II: femur d1202, p01110; patella d001; tibia d0010, v2020, p1110, r1010; metatarsus d0102, v2021, p1101, r1101. III: femur d1202, p01101; patella d001; tibia d1010, v010, p1010, r1010; metatarsus d0100, v221, p1102, r1101. IV: femur d10102, p0001; patella d001; tibia d1010, v1102, p0001, r0001; metatarsus d010, v221, p112, r1012. Female (KS70125)—I: femur d1202, p0011; tibia d1000, v1100, p1010, r0110; metatarsus d0102, v2021, p1010, r0110. II: femur d1102, p0101; tibia d0001, v2200, p1010, r110; metatarsus d0102, v2021, p0101, r0101. III: femur d1202, p01101; patella d001; tibia d1010, v1100, p0110, r1010; metatarsus d0102, v221, p1102, r1101. IV: femur d1102, p001; patella d001; tibia d1010, v1101, p0110, r01010; metatarsus d10101, v211, p1012, r1011.

**Male palp** (Figs 2h–i, 10a–b). Cymbium with a large retrolateral flange and a short coniform to digitiform apex with 2–3 bristle-like spines. Bulb subcircular to ovoid. Tegulum with a basal-retrobasal TL of moderate size, variably offset from base of embolus. Sperm duct visible on the basal tegulum as a long, diagonal S-shaped loop. Embolus spiniform, curving 180° or more from its basal tegular origin to the conductor apex. Conductor T-shaped, with a simple, smooth marginal groove; retrolateral limb tapering to a pointed tip that curves ventrad. Tegular window large to very large, prolaterally placed. MA large, bipartite; medial process a membranous lobe; lateral process large, strongly sclerotized and distally bifurcate spiniform—a large terminal spine with a smaller spine at its base, giving the process a “claw-like” appearance (Figs 2i, 11b) (except in *J. australis* where the smaller spine is greatly reduced [Fig. 12b]). Tibia about as long as wide, with 2–3 long prolateral bristles and two distal apophyses—RVTA short, bluntly beak-like ventrally, widest in lateral view and extended dorsally into a more or less pointed process; RDTA a short, concave, pointed process. Patella about as long as wide with a dorsal bristle.

**Epigynum** (Fig. 9c–g). Fossa divided or undivided (*J. australis*—Fig. 12c); divided fossae with a sclerotized longitudinal septum, enlarged posteriorly as a prominent ventral protuberance varying in shape from a rounded knob to a narrow, keel-like ridge. Internal genitalia simple, with a pair of copulatory ducts opening anterolaterally and curving dorsally above the spermathecae; spermathecae globose and separated, wider than copulatory ducts and placed in middle or posterior half of fossa (visible through cuticle).

**Spinnerets** (Figs 3a–f, 4e). Cribellar plate bipartite, each field about 4.5× as wide as long and separated by a moderately wide seam (about 0.3× a field width); seam and posterior plate margin strongly sclerotized, latter medially indented. In male, cribellum almost as wide as in female with small, non-functional fields. Spigots (female, *J. johnnoblei*—KS59252). ALS: 2 MAP spigots, mesal, adjacent, unequal; c. 65 piriform spigots; PMS: 1 mAP with 5–6 fused paracribellar bases (each with c. 6–11 spigots) grouped anteroectally around mAP; 13 aciniform spigots (1 anterior, rest distributed); 1 cylindrical spigot; PLS: c. 30 aciniform spigots, distributed; 1 subapical “modified PLS” spigot flanked by 3 paracribellar spigots, all free; 2 cylindrical spigots (1 basal, 1 subapical).

**Included species.** *Jamberoo johnnoblei* n.sp., *J. australis* n.sp., *J. boydensis* n.sp., and *J. actensis* n.sp.

## Remarks.

In *Jamberoo* spp. the conductor is of the unmodified “T-shaped” type, the limbs of the T showing some specific size variation. The bipartite median apophysis is distinctive, typically consisting of a fleshy medial process and a sclerotized, bifurcate spiniform (“claw-like”) lateral process. The epigynal fossa is typically divided by a well-defined, sclerotized septum terminating posteriorly in a prominent ventral protuberance (this protuberance may be broken off or obscured, along with the fossae openings, by mating plug secretions). *Jamberoo australis* varies from this typical plan—the fossa lacks a septum and the smaller spine of the lateral MA “claw” is greatly reduced. Such intrageneric genitalic variation has also been noted in other borraline genera—*Therlinya*, *Pillara* and *Elleguna*.

## *Jamberoo johnnoblei* n.sp.

Figs 2h,i, 3a–j, 4a–g, 5a–c, 8a, 9a–g

**Type material. New South Wales:** HOLOTYPE: ♂, KS84009, Mt Keira, 34°24'S 150°51'E, 25 Jan. 1978, M.R. Gray, in log. PARATYPES: ♀, KS84010, data as holotype; ♂, KS34756, Clyde Mtn, E of Braidwood, 35°33'S 149°57'E, 10 Sep. 1975, M.R. Gray, open forest web in dry log; ♂, KS58203, Macquarie Pass, 34°34'S 150°39'E, 12 Sep. 1999, H.M. Smith, in web on rotting log; 5 ♀♀, KS57680, KS59251, KS60710, KS67201, KS84012, data as for KS58203, all reared to maturity between late Sep. and late Dec. 1999; ♂, KS8643, ♀, KS84013, Royal National Park, 34°08'S 151°04'E, 2 Dec. 1981, Horseman & Harland, under moss; ♀, KS60772, as KS8643, Sep. 1997, H.M. Smith, sheet web in rotting log, taken as juvenile, matured Jan. 1998; ♂, KS60773, as KS8643, Wattamolla Track, 27 Sep. 1997, H.M. Smith.

**Other material. New South Wales:** ♀, KS67897, Jamberoo Mtn, 34°40'S 150°43'E, 6 Nov. 1995, J. Noble; ♂, KS46335, Brown Mtn, 16 km W of Bemboka, 36°36'S 149°23'E, 16 Apr. 1978, M.R. Gray, small sheet webs in roadside bank, 800 m; ♀, KS59252, Macquarie Pass, 34°34'S 150°39'E, 12 Sep. 1999, H.M. Smith, in web on rotting log, matured 30 Sep; abdomen used for SEM; ♀, KS77021, Bodalla SF, 8 km NW Central Tilba near Mt Dromedary t.o., 36°16'S 150°03'E, 17 Apr. 1978, M.R. Gray, on bank; ♀, KS60771, Mt Keira, 34°24'S 150°51'E, M.R. Gray, in soil bank, abdomen used for SEM; ♂, KS8503, Mount Wilson, 33°30'S 150°23'E, 28 Oct. 1981, C. Horseman, under log; ♀, KS69655, Mt Wilson, Cathedral of ferns, 33°30'S 150°22'E, M.R. Gray, 17 Jan. 1978; ♀, KS34763, data as KS69655, 21 Jan. 1975, M.R. Gray, large sheet web in upturned base of log at cleared edge of rainforest; ♀, KS75403, Mt Wilson, near Cathedral of Ferns, 33°30'S 150°23'E, 28 July 2001, M.R. Gray, earth bank, sheet web (matured in captivity 11 Aug. 2001); 2 ♀♀, KS6468–9, Royal National Park, 34°08'S 151°04'E, 16 Jan. 1981, M.R. Gray, dry sclerophyll, in large sheet webs up to 40 × 40 cm, from sides of fallen logs & stumps; ♀, KS8332, as KS6468, 14 Oct. 1981, C. Horseman, in bank; 2 ♀♀, KS8725, KS10779, Somersby Falls, 33°24'S 151°17'E, 18 Jan. 1982, M.R. Gray, under rock, conical sheet web; ♀, KS55753, Dampier SF, Coomerang Rd, 36°03'57"S 149°47'05"E, 11 Mar. 1999, H.M. Smith; 4 ♀♀, KS9028, KS9030, KS9032, Minnamurra Falls Reserve, 34°38'S 150°44'E, 20 Apr. 1982, C. Horseman; ♀, KS55754, Monga SF, Link Rd, 35°34'04"S 149°54'14"E, 16 Mar. 1999, H.M. Smith; 2 ♀♀, KS55755–6, data as KS55754, 29 Mar. 1999; ♀, KS55723, nr Monga, 35°35'S 149°55'E, 30 Mar. 1999, H.M. Smith; ♀, KS77023, Mooney Mooney Ck, S of road bridge, 33°31'S 151°12'E, 12 Jan. 1977, M.R. Gray, small sheet web in log; ♀, KS55724, 7.5 km S of Nelligen, Mogo SF, 35°43'19"S 150°06'50"E, 29 Mar. 1999, H.M. Smith & M. Tio, laid egg sac c. 1 May 1999.

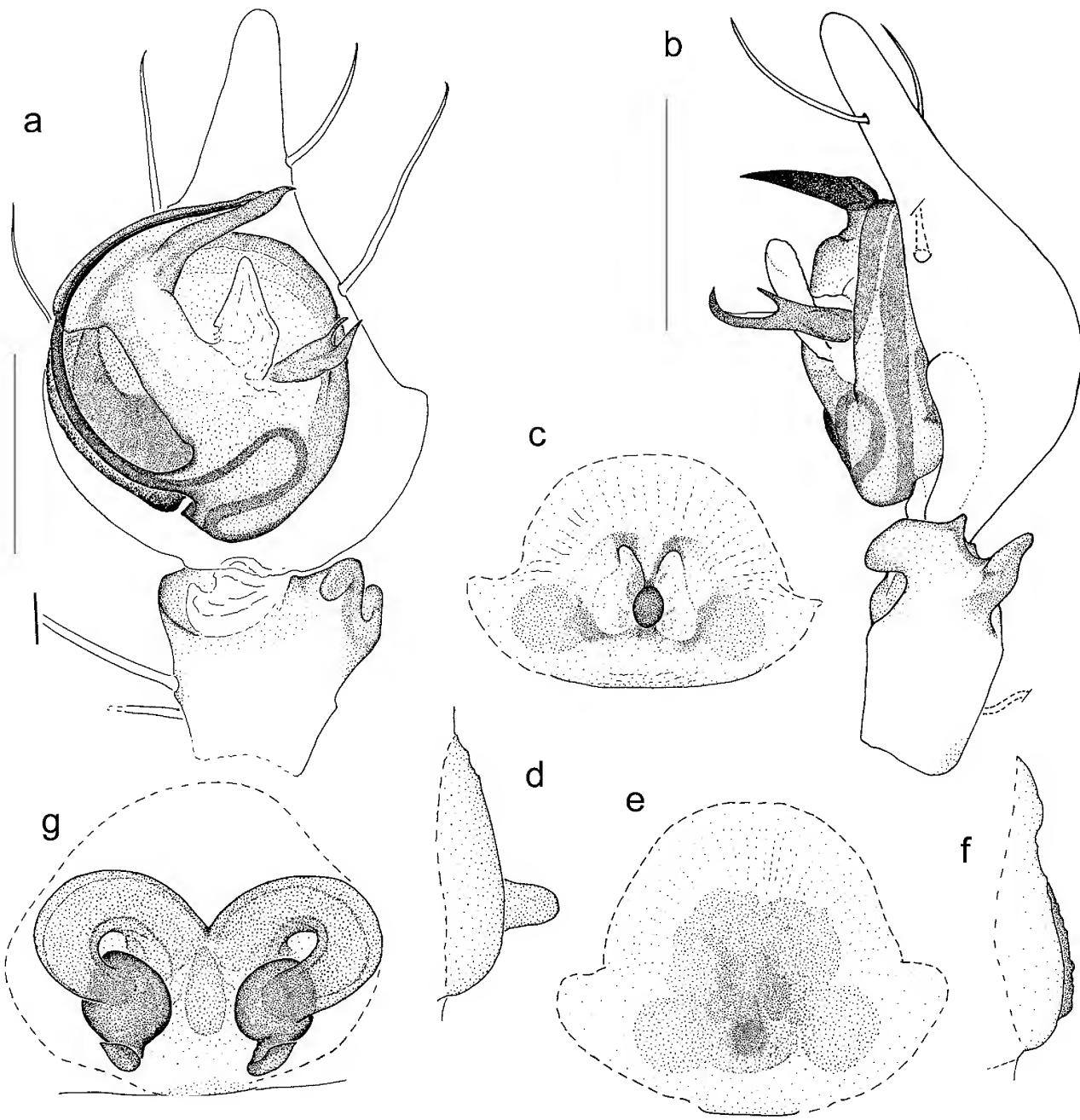


Fig. 9. *Jamberoo johnnoblei*. (a, b), male palp: a, ventral (holotype); b, retrolateral (KS46335). (c–g), epigynum: c, ventral, d, lateral (KS84010); e, f, plugged and damaged (KS69656); e, ventral; f, lateral; g, dorsal—internal genitalia (KS69656). Scale lines 0.5 mm: upper lines, a, b; lower line, c–g.

**Diagnosis.** Separated from *J. boydensis* and *J. australis* by the distally “claw-like” appearance of the large sclerotized lateral process of MA; and from *J. australis* by the presence of an epigynal septum. Differs from the closely related *J. actensis* by the digitiform shape of the distal cymbium, relatively longer prolateral conductor limb and epigynal fossae narrowest anteriorly.

### Description

**Male** (holotype). BL 7.50, CL 4.17 (range 2.65–4.24), CW 3.08, CapW 1.80, EGW 1.18, LL 0.68, LW 0.68, SL 2.08, SW 1.63. Legs 1243, long (I: 27.00; II: 22.50; III: 16.92;

IV: 20.33); ratio tibia I length:CW = 1:0.43. Male palp (Fig. 9a, b). Cymbium apex short digitiform. Bulb subcircular, about as wide as long. Conductor with a short to very short prolateral limb, about a third length of retrolateral limb. TW of moderate size, prolateral. TL basal, prolateral margin rounded to bluntly coniform. Sclerotized lateral MA process large with a strong spiniform “claw”—the curved, terminal spine wide basally and inner surface concave (Fig. 2i)

**Female** (KS84010). BL 7.92, CL 3.02 (range 2.81–4.73), CW 2.08, CapW 1.39, EGW 0.94, LL 0.51, LW 0.51, SL 1.43, SW 1.31. Legs: 1423 (I: 12.78; II: 10.20; III: 8.90; IV:

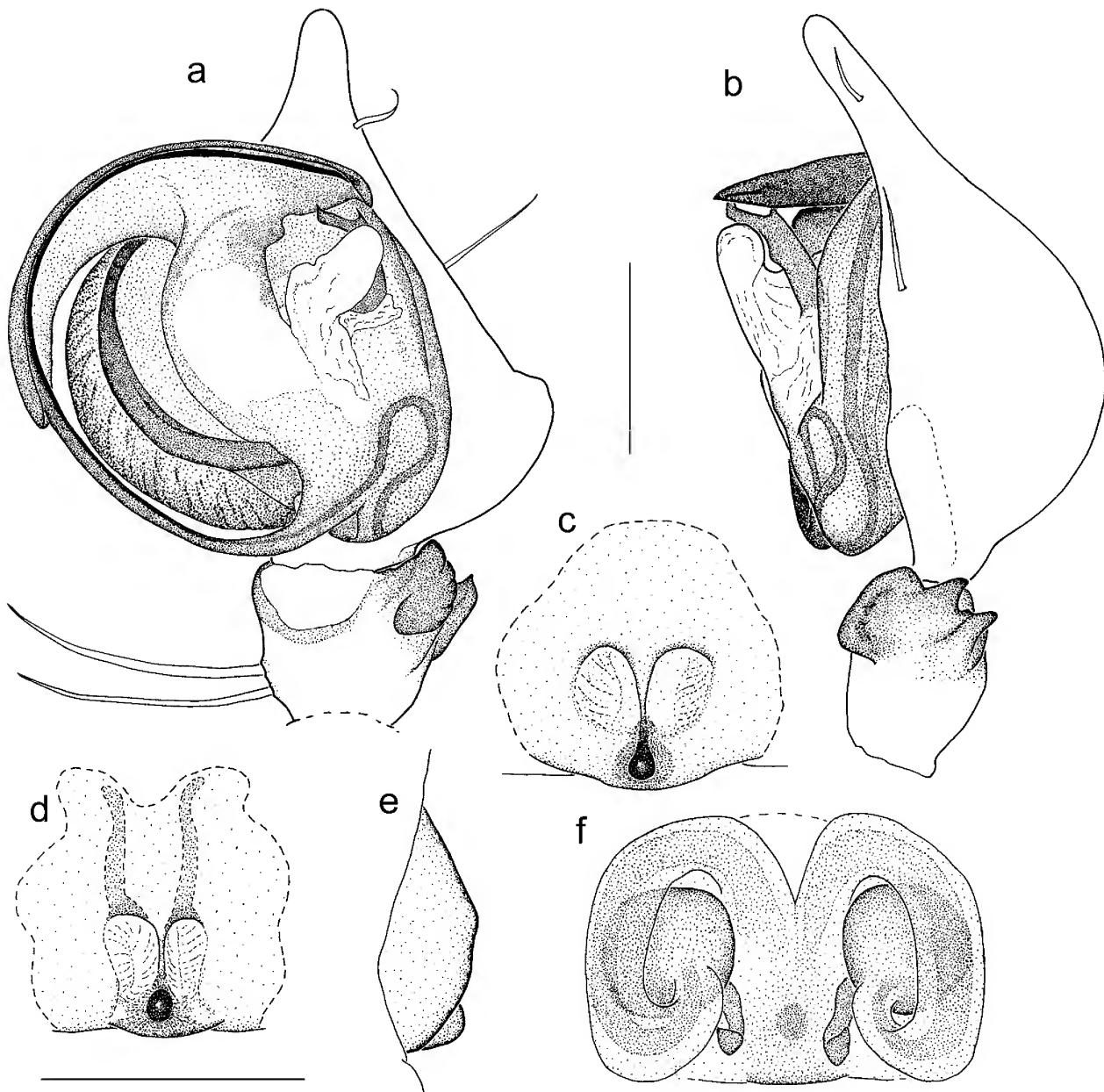


Fig. 10. *Jamberoo boydensis*. (a, b), male palp (holotype): a, ventral; b, retrolateral. (c–f), epigynum: c, d, ventral (KS34761, KS34759); e, lateral (KS34759); f, dorsal—internal genitalia (KS10256). Scale lines 0.5 mm: upper, a, b; lower, c–f.

10.49); ratio tibia I length:CW = 1:0.65. Epigynum (Fig. 9c–g). Fossae narrowest anteriorly. Median septum short, tapering posteriorly before expanding abruptly into a ventral sclerotized knob-like protuberance—note that the latter may vary in shape from the usual rounded to ovoid knob to a thin, keel-like lamina—that is usually placed clearly anterior to the epigastric groove. Internal genitalia with short, curved copulatory ducts and relatively small spermathecae, well separated.

**Distribution.** Southern and central coast and highlands of New South Wales.

**Etymology.** The species is named in honour of Mr John S. Noble OM, engineer, conservationist, spider collector and photographer, and a long-time friend of the museum's Arachnology Section.

### *Jamberoo boydensis* n.sp.

Figs 8a, 10a–f

**Type material. New South Wales:** HOLOTYPE: ♂, KS76979, Boyd Plateau, 34°00'S 150°03'E, M.R. Gray, in logs. PARATYPES: ♀, KS34761, Mt Edwards, Boyd Plateau, 33°50'S 150°00'E, 26 Nov. 1974, M.R. Gray, in log; ♀, KS34759, data as holotype; ♀, KS34762, Boyd River crossing, Boyd Plateau, 34°03'S 150°05'E, M.R. Gray, 26 Nov. 1974, under log. ♀, KS34760, Mt Wiburd, Boyd Plateau, 33°50'S 150°01'E, 5 May 1974, M.R. Gray, eucalypt-Poa assn, webs on logs.

**Diagnosis.** Differs from other species by the elongate palpal prolateral conductor limb and the relatively long, slender epigynal septum with a small, rounded posterior knob. .

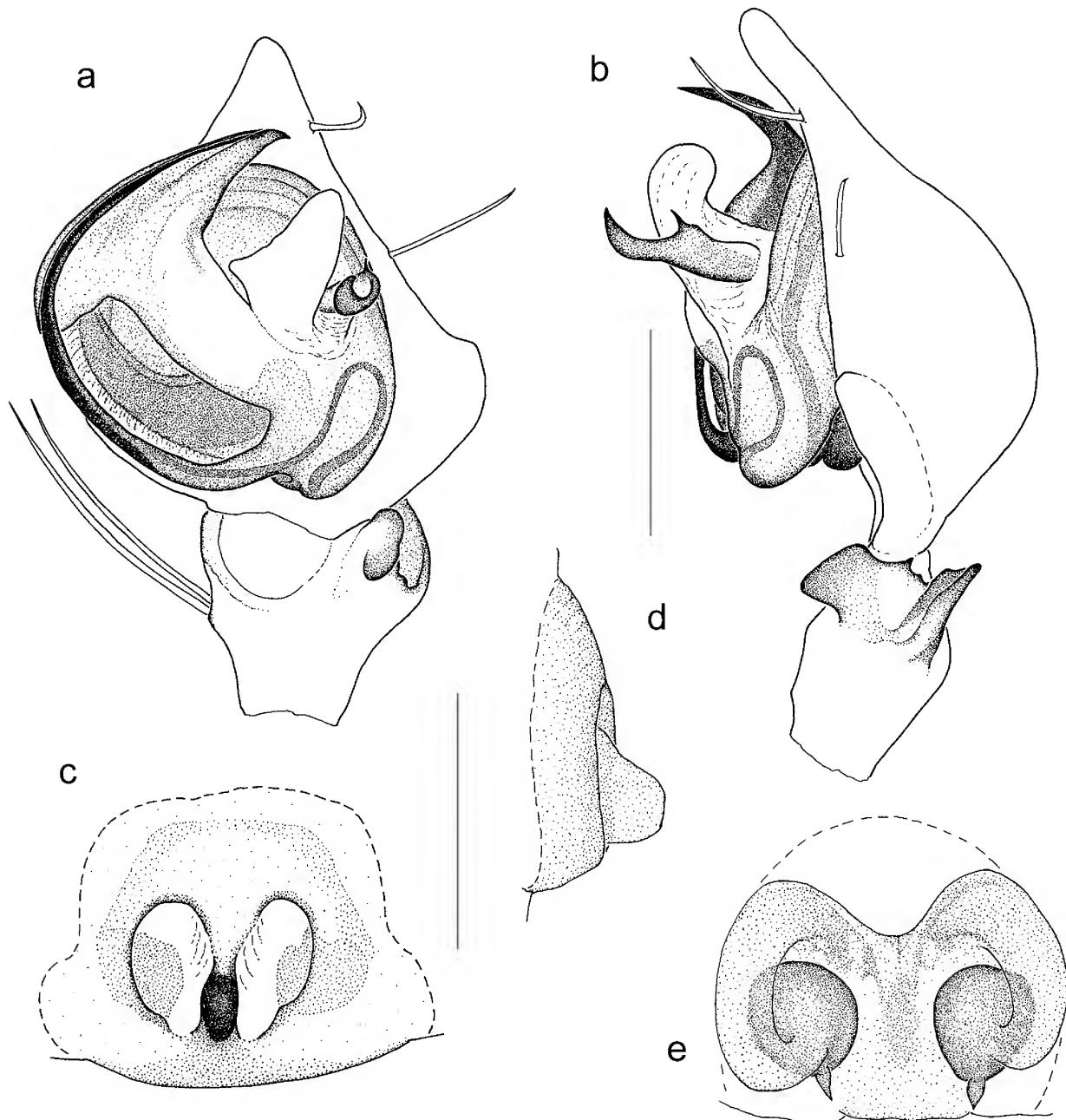


Fig. 11. *Jamberoo actensis*. (a, b), male palp (holotype): a, ventral; b, retrolateral. (c–e), epigynum (KS60770): c, ventral; d, lateral; e, dorsal—internal genitalia. Scale lines 0.5 mm: upper, a, b; lower, c–e.

### Description

**Male** (holotype). BL 6.86, CL 3.35, CW 2.45, CapW 1.31, EGW 0.94, LL 0.45, LW 0.49, SL 1.57, SW 1.37. Legs: 1423 (I: 14.82; II: 12.45; III: 10.41; IV: 12.65); ratio tibia I length:CW = 1:0.66. Male palp (Fig. 10a,b). RTVA with dorsal process prominent. Cymbium apex short digitiform. Bulb ovoid, wider than long. Prolateral conductor limb elongated, much longer than retrolateral limb. TW prolateral to basal and very large. TL retrobasal with prolateral margin rounded. Sclerotized lateral process of MA with small “claw-like” bifurcation apically (much smaller than in *J. johnnoblei* and *J. actensis*).

**Female** (KS34761). BL 6.29, CL 2.82 (range 2.73–3.31), CW 1.88, CapW 1.18, EGW 0.88, LL 0.41, LW 0.47, SL 1.39, SW 1.21. Legs: 1423 (I: 10.49; II: 8.61; III: 7.59; IV: 9.06); ratio tibia I length:CW = 1:0.72. Epigynum (Fig. 10c–f). Median septum long and slender, with a small, rounded knob placed posteriorly near the epigastric groove. Internal genitalia with copulatory ducts looping dorsolaterally to enter the spermathecae posteriorly; spermathecae large, well separated.

**Distribution.** Known only from the type locality.

**Etymology.** The name is taken from the type locality.

### *Jamberoo actensis* n.sp.

Figs 8a, 11a–e

**Type material. Australian Capital Territory:** HOLOTYPE: ♂, KS76978, 1 km SW of Gibraltar Falls on Corin Dam Rd, Tidbinbilla Ra, 35°28'S 148°57'E, 10 Dec. 1977, M.R. Gray, sheet web on log. PARATYPE: ♀, KS60770, data as for holotype.

**Diagnosis.** Like *J. johnnoblei* but differs as follows: distal cymbium short and coniform; palpal bulb broader; TL more retrobasally placed; and epigynal fossae broadest anteriorly.

#### Description

**Male (holotype).** BL 6.65, CL 3.18, CW 2.24, CapW 1.31, EGW 0.90, LL 0.45, LW 0.47, SL 1.49, SW 1.33. Legs: 1243 (I: 15.35; II: 12.65; III: 10.45; IV: 12.61); ratio tibia I length:CW = 1:0.57. Male palp (Fig. 11a,b). Cymbium apex short coniform. Bulb subcircular, about as wide as long. Conductor with a short prolateral limb, about half as long as retrolateral limb. TW long, prolateral to basal. TL retro-basal with prolateral margin rounded. Sclerotized MA process similar to *J. johnnoblei*.

**Female (KS60770).** BL 7.96, CL 3.35, CW 2.12, CapW 1.55, EGW 0.98, LL 0.57, LW 0.55, SL 1.61, SW 1.41. Legs: 1423 (I: 13.18; II: 11.18; III: 9.47; IV: 11.63); ratio tibia I length:CW = 1:0.64. Epigynum (Fig. 11c–e). Fossae relatively large and broadest anteriorly. Median septum short and wide, tapering and rising posteriorly as an ovoid protuberance, about as long as the anterior septum. Internal genitalia similar to *J. johnnoblei*.

**Distribution.** Known only from the type locality.

**Etymology.** The species name is taken from the acronym for the Australian Capital Territory (ACT).

### *Jamberoo australis* n.sp.

Figs 8a, 12a–e

**Type material. Victoria:** HOLOTYPE: ♂, KS46337, Box Corner, 4.5 km N of Mount Buller village, 37°09'S 146°27'E, 1000 m, 8 Apr. 1978 (specimen matured 3 Jan. 1979), M.R. Gray. PARATYPES: ♂, KS46338, collected mature, otherwise data as holotype; ♀, KS77020, Box Corner, Mt Buller, 37°09'S 146°27'E, 16 Nov. 1982, M.R. Gray; ♂, KS77022, La La Falls, Warburton, 37°45'S 145°42'E, 13 Mar. 1954, A. Neboiss.

**Other material. Victoria:** ♂, KS46336, 7 km E of Mirimbah on Mount Stirling Road, 37°09'S 146°57'E, 8 Apr. 1978, M.R. Gray, 920 m; ♀, KS46081, 3 km NE of Mirimbah, 37°07'S 146°56'E, 21 Apr. 2002, M.R. Gray; ♀, KS34754, Sherbrooke Forest, 37°53'S 145°22'E, 19 Jan. 1955.

**Diagnosis.** Differs from other species in having the lesser spine on the spiniform sclerotized lateral process of MA reduced to a spicule (not “claw-like”); and the epigynal fossa without a dividing septum.

#### Description

**Male (holotype).** BL 8.80, CL 4.12 (range 3.22–4.16), CW 2.84, CapW 1.71, EGW 1.14, LL 0.68, LW 0.61, SL

1.95, SW 1.62. Legs: 1243 (I: 19.73; II: 16.33; III: 13.40; IV: 15.40); ratio tibia I length:CW = 1:0.56. Sternum dark brown. Male palp (Fig. 12a,b). RVTA large, anvil shaped (lateral view). Cymbium apex short coniform. Cymbial flange very wide. Bulb wider than long. Prolateral margin of TL rounded, sometimes with a small thorn-like protuberance. Lateral process of MA slender spiniform, with secondary spine reduced to a spicule (Fig. 12b).

**Female (KS77020)** BL 8.41, CL 3.80 (range 3.80–4.29), CW 2.65, CapW 1.80, EGW 1.16, LL 0.65, LW 0.65, SL 1.88, SW 1.57. Legs: 1243 (I: 14.83; II: 12.67; III: 10.67; IV: 12.33); ratio tibia I length:CW = 1:0.71. Sternum dark brown. Epigynum (Fig. 12c–e). Fossa open, without median septum or posterior knob, longer than wide, narrowest anteriorly. Internal genitalia (KS46081) with short copulatory ducts and large spermathecae separated by about a third of spermatheca width.

**Comments.** All other *Jamberoo* species have a divided epigynal fossa. Possession of an open fossa initially precluded placing the Mt Buller–Mirimbah males and females together. However, collecting has not revealed a second “striped” species in this region so that the male–female matching seems reliable. The midline area of the fossa rises ventrally from front to back, possibly reflecting a former or incipient division of the fossa.

**Distribution.** Southern Great Dividing Range, eastern Victoria.

**Etymology.** The name refers to the southern distribution of this species.

### *Karriella* n.gen.

**Type species.** *Karriella treeensis* n.sp.

**Etymology.** The genus name is a reference to the Karri forests associated with the southwestern Australian distribution of this genus and is considered feminine in gender.

**Diagnosis.** Separated from all other genera by the epigynum having a pair of lateral sclerotized knobs posteriorly; fossa undivided. Palpal RDTA with a deep, dorsal groove; lateral MA process a large spiniform hook with a laminar, scale-like spine basally.

**Description.** Medium-sized, cribellate spiders (CL 2.45–4.90). Similar to *Couranga* in general characters. Putative stridulatory organ usually present, weakly to well-defined, consisting of basally thickened hairs in 1–2 rows or scattered on retrolateral paturon, opposite an elongate patch of minute thorn-like setae on prolateral basal half of palpal femur (Fig. 15a–d).

**Legs.** 1423. Male metatarsus I distally thin (but not obviously flattened) and weakly bowed (retrolaterally concave); metatarsus II little modified. Spination: representative leg spination (*K. treeensis*): Male (KS14774)—I: femur d122, p011; tibia d0010, v1222, p1110, r1010; metatarsus d212, v221, p1001, r0101; II: femur d122, p011 (001); tibia d0010, v222, p1010 (1110), r1010; metatarsus d2102, v221, p0101, r0101; III: femur d122, p011; patella d101; tibia d1010, v212, p1010, r1010; metatarsus d2102, v221, p0101,

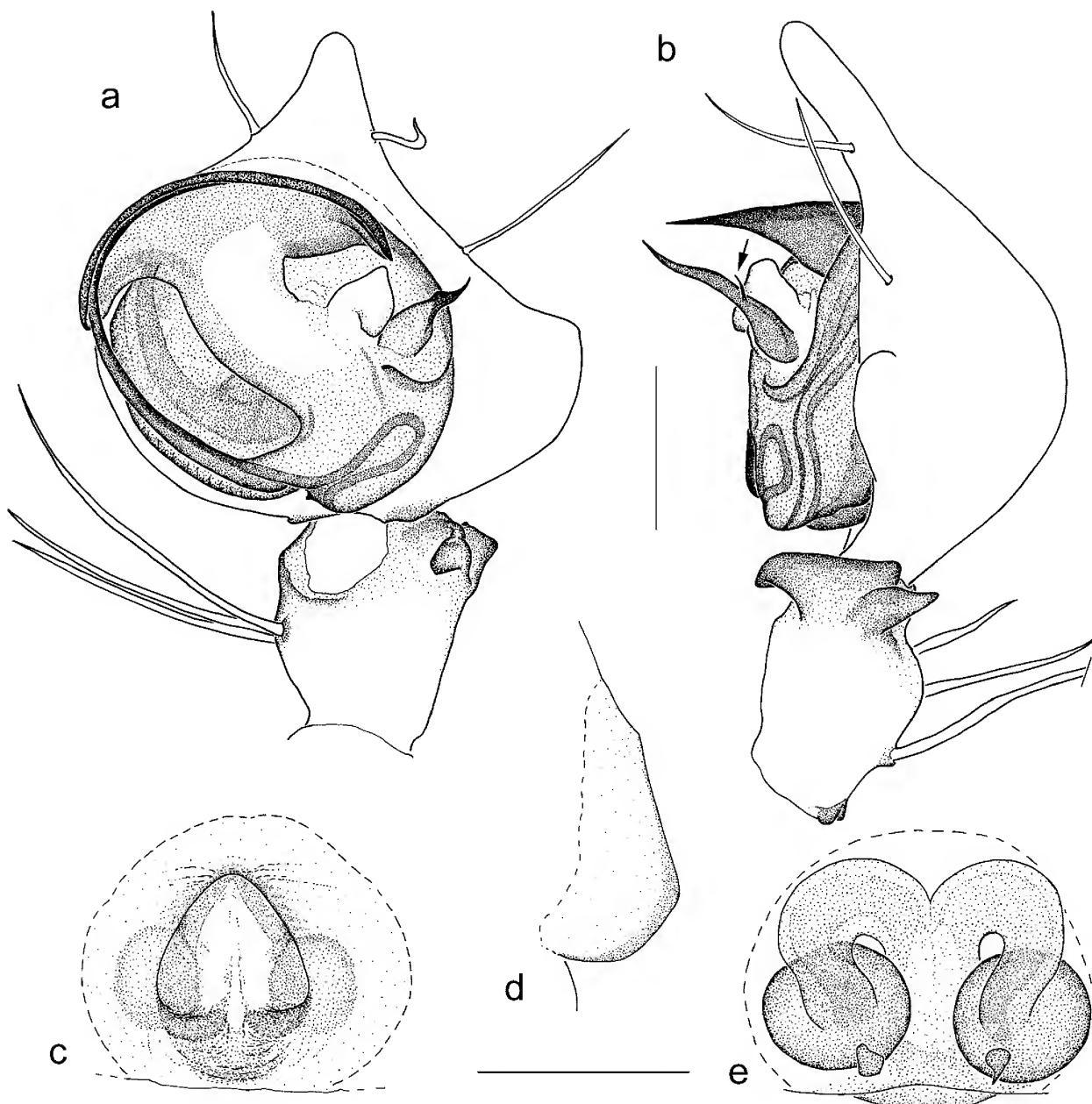


Fig. 12. *Jamberoo australis*. (a, b), male palp (holotype): a, ventral; b, retrolateral (arrow to spicule on lateral process of MA). (c–e), epigynum: c, ventral, d, lateral (KS77020); e, dorsal—internal genitalia (KS46081). Scale lines 0.5 mm: upper, a, b; lower, c–e.

r0101; IV: femur d112, p001; patella d101; tibia d1010, v112, p1010, r1010; metatarsus d222, v221, p0101, r001. Female (KS14775)—I: femur d122, p011; tibia d0010, v222(1222), p1110, r1010; metatarsus d212, v221, p0101, r0101; II: femur d122, p111(101); tibia d0010, v222, p1110, r1010; metatarsus d212, v221, p0101, r0101; III: femur d122, p011; patella d101; tibia d1010, v112(122), p1010, r0110; metatarsus d212, v221, p0101, r0101; IV: femur d112, p0101; patella d101; tibia d1010, v112, p1010, r1010; metatarsus d222, v221, p0101, r001.

**Male palp** (Figs 2e–g, 13a–c). Cymbium with a coniform apex with 3 bristle-like spines; apical margin of retrolateral flange not offset from cymbium. Bulb rounded. Tegular lobe reduced, small or indistinct; distally curved sperm duct compressed into basal bulb, course partly obscured. Embolus a tapering, semicircular spine, its distal part clasped within the

conductor marginal groove. Conductor a truncated, modified T-shape (prolateral limb absent, retrolateral limb broad), anterodorsal margin with flange-like processes anterior to the marginal groove; distal conductor curved ventrally, tapering to a pointed apex. Tegular window prolateral-basal, of moderate size. MA bipartite, membranous medial process low and ridge-like; sclerotized lateral process a large hook-shaped spine with a laminar, scale-like spine at base. Tibia about as long as wide, with 3 prolateral setae (two robust, spine-like; one a shorter, dorsad bristle), and two distal apophyses; RVTA short and blunt, RDTA a broad plate with a dorsal slit or pit-like groove. Patella about as long as wide with a long dorsal bristle reaching level of basal cymbium.

**Epigynum** (Fig. 13d–g). Fossa an undivided shallow pit, longer than wide, deepest and rounded anteriorly, shallower and margins weak to absent posteriorly; posterolateral

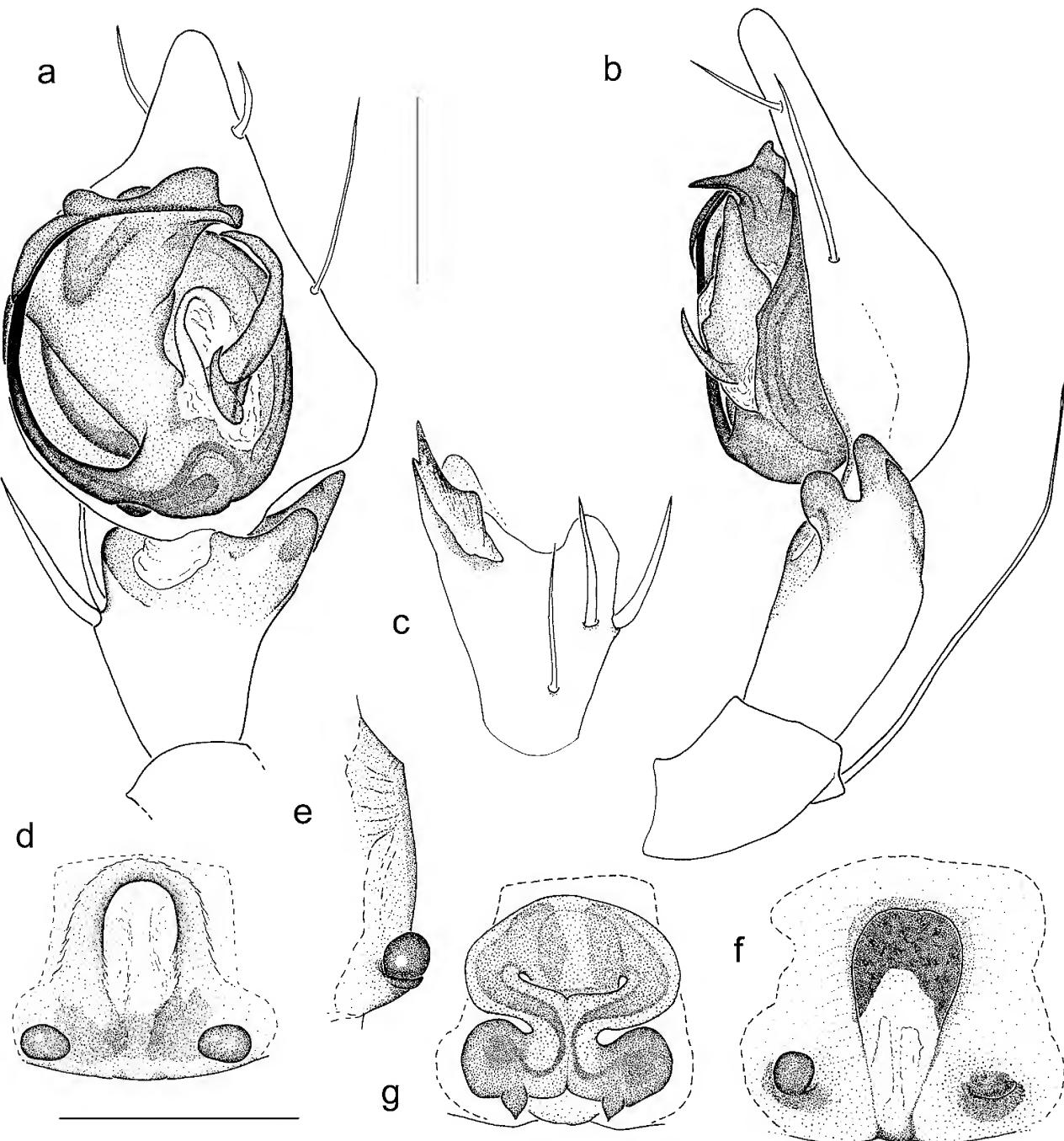


Fig. 13. *Karriella treenensis*. (a–c), male palp (holotype): a, ventral; b, retrolateral; c, tibia, dorsal. (d–g), epigynum: d, ventral (KS14775); e, lateral (WAM T78285); f, plugged and damaged epigynum, ventral (KS14862); g, dorsal—internal genitalia (KS14690). Scale line 0.5 mm: upper, a–c; lower, d–g.

epigynum with a pair of strongly sclerotized, knob-like protuberances (may be damaged or broken off). Internal genitalia with a pair of short, wide, S-shaped copulatory ducts which meet in the midline before entering the spermathecae medially; spermathecae globose and separated, placed under the sclerotized “knobs” on the posterior epigynum. Spinnerets. Cribellar fields c. 4.0× as wide as long and separated by a seam about 0.2× a field width. Spigots (female, KS85058): ALS: 2 MAP spigots, mesal, adjacent, unequal; c. 40 piriform spigots; PMS: 1 mAP spigot; 5 paracribellar multi-spigot fused bases (2–7 spigots each) grouped anteroectally around mAP; 9 aciniform spigots (1 anterior, rest

distributed); 1 cylindrical spigot, posteroectal; PLS: c. 35 aciniform spigots, distributed; 1 subapical “modified PLS” spigot flanked by 3 paracribellar spigots, all free; 2 cylindrical spigots (1 basal, 1 central).

**Included species.** *Karriella treenensis* n.sp., and *K. walpolensis* n.sp.

**Remarks.** These spiders are confined to the southern Karri forest region of Western Australia. In mated females one or both epigynal “knobs” are usually damaged; an epigynal plug also may be present in the fossa. Modification of the

male anterior conductor margin is similar to that seen in *Couranga* spp. The putative stridulatory structures are variably developed in both males and females. Similar structures are found in males of *Elleguna* spp.

### *Karriella treeensis* n.sp.

Figs 2e–g, 8c, 13a–g, 15a–b

**Type material. Western Australia:** HOLOTYPE: ♂, KS14774, Treen Brook, 5 km SE of Pemberton, 34°26'S 116°04'E, 11 Feb. 1979, M.R. Gray, in log. PARATYPES: 3 ♀ ♀, KS14775, KS82652–3, data as holotype; ♀, KS14792, Treen Brook SF, 8 km west of Pemberton, 34°26'S 116°02'E, 12 Feb. 1979, M.R. Gray, in litter; 3 ♂ ♂, KS34750, KS82654–6, Manjimup, 34°15'S 116°09'E, 1971, J. Springett, SW Forest Survey Ref 19FSS; ♂, WAM T78284, data as KS82654–6; ♂, 2 ♀ ♀, WAM 74/7–10, 12 miles W of Manjimup, ca 34°13'S 115°56'E, 11 Mar. 1971, H. Butler, litter.

**Other material. Western Australia:** 2 ♀ ♀, KS14690, KS85058, Warren NP, Old Vasse Road, 34°30'S 116°00'E, 10 Feb. 1979, M.R. Gray, large filmy horizontal sheet web suspended from low mossy bark on karri trunk; ♂, KS14702, Dombakup SF, 34°30'S 116°00'E, 4 Feb. 1979, M.R. Gray, in sheet web on dry culvert bank, palp used for SEM; 3 ♂ ♂, KS15305, Pine Creek, 0.5 km from Quarty Rd, Nannup–Pemberton area, 34°15'S 115°50'E, 14 Feb. 1979, M.R. Gray, pitfall traps in litter, 26 Jan.–4 Mar. 1979; ♂, KS34749, ♀, KS34751, Pemberton, Brockman NP, 34°30'S 116°00'E, 22 Jan. 1974, M.R. Gray, under logs in karri forest; ♀, KS34752, Pemberton, 34°30'S 116°00'E, 1971, J. Springett, SW Forest Survey Ref 21FSS; ♀, KS34753, Shannon River (Nelson Rd) Northcliffe, 34°39'S 116°21'E, Jan. 1974, M.R. Gray, in webs on river bank—web in expanding half bell shape, 30 cm diameter; 2 ♀ ♀, KS14862, Boranup Drive, off Caves Road near Karridale, 34°05'S 115°03'E, 14 Feb. 1979, M.R. Gray, in sheet webs in soil banks and in hanging curled bark near ground; 2 ♂ ♂, KS15143, as KS14862 but pitfall traps, 26 Jan.–3 Mar. 1979.

**Diagnosis.** Differs from *K. walpolensis* by the slit-like dorsal groove on the male palpal RDTA; female with epigynal fossa relatively wider and copulatory ducts shorter and arranged in a compact S-shape.

### Description

**Male (holotype).** BL 5.02, CL 2.45 (range 2.45–3.55), CW 2.04, CapW 1.10, EGW 0.78, LL 0.39, LW 0.45, SL 1.33, SW 1.14. Legs: 1423 (I: 11.51; II: 9.92; III: 8.57; IV: 10.20); ratio tibia I length:CW = 1:0.70. Male palp (Fig. 13a–c). Palpal bulb longer than wide. Dorsal groove on RDTA narrow, slit-like. Distal conductor with a large, crest-like process sub-apically. Putative stridulatory bristles on retrolateral paturon, either in 1–2 rows (Fig. 15a) or more scattered (occasionally indistinct); prolateral basal half of femur with a row or patch of very short setae with thickened bases (Fig. 15b).

**Female (KS14775).** BL 6.33, CL 3.18 (range 2.92–3.62), CW 2.04, CapW 1.39, EGW 0.94, LL 0.47, LW 0.47, SL 1.45, SW 1.25. Legs: 1423 (I: 10.98; II: 9.35; III: 8.12; IV: 9.88); ratio tibia I length:CW = 1:0.74. Stridulatory organ present but less strongly developed than in male, setae grouped irregularly, not in row. Epigynum (Fig. 13d–g). Fossa an inverted U-shape (Fig. 13d), may be narrowed posteriorly (Fig. 13f); fossa length (from anterior margin to line between epigynal knob centres) c. 2× fossa width. Fossa sometimes plugged and the posterior epigynal “knobs” may be damaged or missing (Fig. 13f). Internal genitalia with copulatory ducts and spermathecae making a tight S-shape.

**Variation.** The bowed male metatarsi I are sometimes pencilled laterally with a pair of dark brown longitudinal lines. Specimens from the Karridale/Boranup area east of Pemberton lack any obvious cheliceral “stridulatory” setae.

**Distribution.** The Pemberton–Karridale region of the southwest corner of Western Australia.

**Etymology.** The species name refers to Treen Brook, W.A., the type locality.

### *Karriella walpolensis* n.sp.

Figs 8c, 14a–e, 15c,d

**Type material. Western Australia:** HOLOTYPE: ♂, WAM T78282, Walpole-Nornalup NP, Hill Top Rd, 34°57'S 116°46'E, M.R. Gray, pitfall traps in litter, 31 Jan.–5 Mar. 1979. PARATYPES: ♀, KS14554, 15 km E of Walpole along Valley of the Giants Rd, 34°56'S 116°48'E, 7 Feb. 1979, M.R. Gray, in log crevice, in retreat funnel with large filmy sheet web, c. 40×20 cm; ♂, KS15383, data as for holotype; 3 ♀ ♀, KS7240, Walpole-Nornalup NP, Hilltop Rd 4 km SW of highway turn-off, 34°58'S 116°46'E, 8 Feb. 1979, M.R. Gray, under logs, large fine mesh, suspended sheet web; ♂, KS14572, as KS7240 but 2 km from highway turn off; ♀, WAM T78283, Walpole-Nornalup NP, Gully Road, 34°58'S 116°47'E, 15 Feb. 1979, M.R. Gray, pitfall traps in litter, 31 Jan.–5 Mar. 1979; ♀, KS14623, Walpole-Nornalup NP, 2 km along Tinglewood-Mt Clare Rd, 34°58'S 116°46'E, 9 Feb. 1979, M.R. Gray, in curled bark, filmy horizontal web c. 30×20 cm extending c. 40 cm above ground; ♀, KS14642, Walpole-Nornalup NP, 34°58'S 116°46'E, 9 Feb. 1979, M.R. Gray, under logs.

**Diagnosis.** Differs from *K. treeensis* by the more open dorsal groove on male palpal RDTA; female with a narrower epigynal fossa and copulatory ducts in a more extended S-shape.

### Description

**Male (holotype).** BL 8.57, CL 4.90 (range 3.67–4.90), CW 3.31, CapW 1.96, EGW 1.22, LL 0.84, LW 0.73, SL 2.37, SW 1.76. Legs: 1(4/2)3 (I: 19.92; II: 17.17; III: 14.58; IV: 17.17); ratio tibia I length:CW = 1:0.66. “Stridulatory” bristles usually present on paturon and palpal femur, but relatively scattered and sometimes indistinct (Fig. 15c,d). Male palp (Fig. 14a–c). Palpal bulb as wide as long. Dorsal groove on RDTA more open and pocket-like. Distal conductor with a smaller flange-like process sub-apically (cf. *K. treeensis*).

**Female (KS14554).** BL 8.94, CL 4.45 (range 3.47–4.57), CW 2.86, CapW 2.16, EGW 1.31, LL 0.76, LW 0.67, SL 1.96, SW 1.67. Legs: 1423 (I: 15.67; II: 13.75; III: 11.92; IV: 14.17); ratio tibia I length:CW = 1:0.72. Epigynum (Fig. 14d,e). Fossa similar in external structure to *K. treeensis*, but usually narrower—fossa length (from anterior margin to line between epigynal knob centres) c. 3× fossa width. Posterior epigynal “knobs” are sometimes damaged or broken off. Internal genitalia with copulatory ducts longer and forming a looser S-shape with the spermathecae, cf. *K. treeensis*.

**Distribution.** Walpole and Nornalup areas of southwest Western Australia.

**Etymology.** The species name refers to the town of Walpole near the type locality.

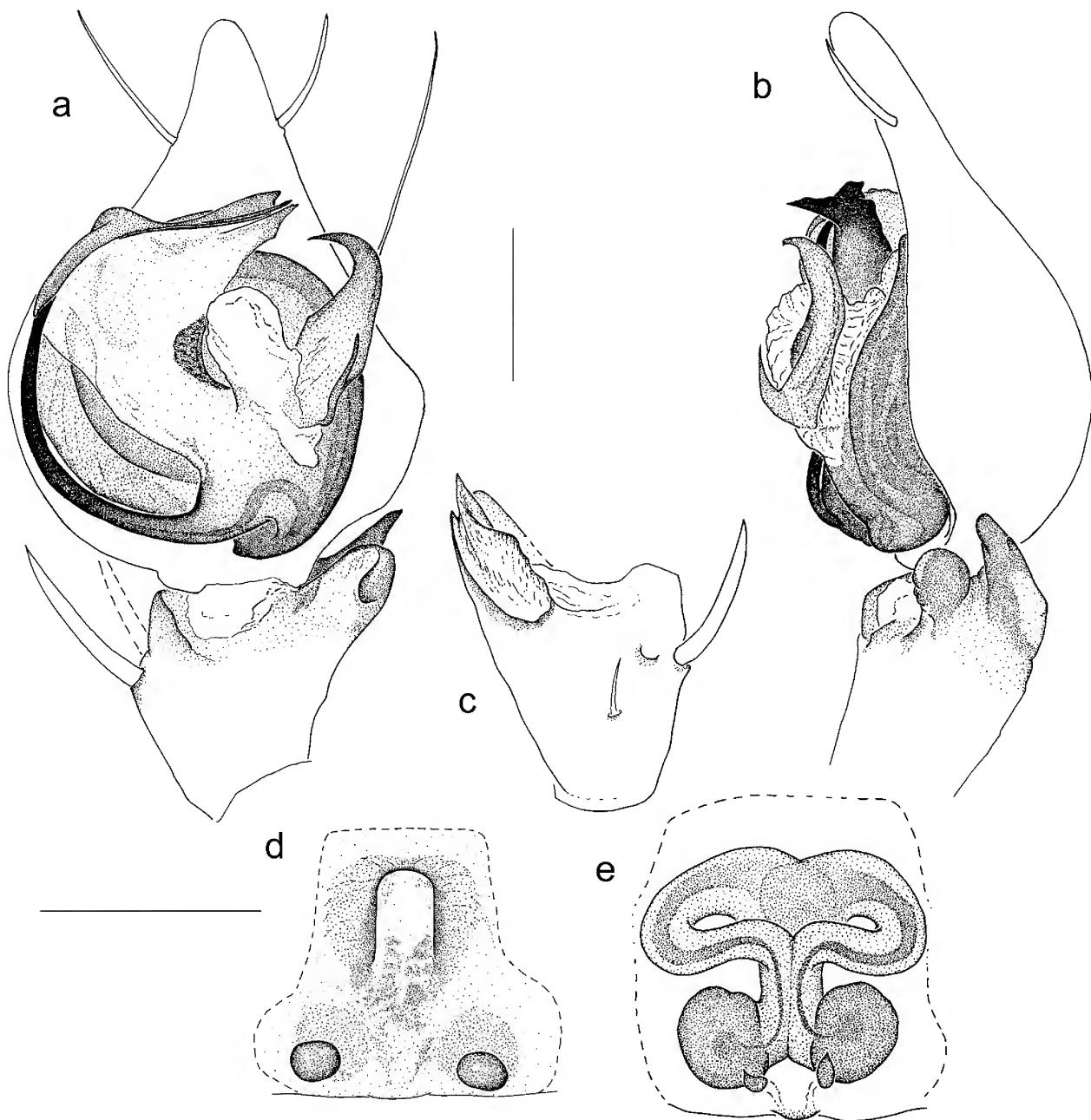


Fig. 14. *Karriella walpolensis*. (a–c), male palp (holotype): a, ventral; b, retrolateral; c, tibia, dorsal. (d, e), epigynum: d, ventral (KS7240); e, dorsal—internal genitalia (KS14642). Scale line 0.5 mm: upper, a–c; lower, d, e.

### *Elleguna* n.gen.

**Type species.** *Elleguna major* n.sp.

**Etymology.** The name is an anagram of Eungella, a reference to the type species locality in mid-east Queensland. The gender is considered to be feminine.

**Diagnosis.** Separated from all other genera by the unique presence of a ventral process on the male palpal conductor; from all except *Therlinya* and *Pillara* by the presence of a unipartite MA; and from all except *Karriella* by the small to indistinct tegular lobe. Females are separated from other genera by the presence of paired “sockets” in the posterior fossa floor or wall.

**Description.** Medium-sized, cibellate spiders (CL 3.10–4.00). Similar to *Couranga* in general characters. Putative cheliceral/palpal stridulatory organ present, but seen in males only, structure similar to that in *Karriella* but with only patch-like, rather than linear, setal groups.

**Legs** 1423. Male metatarsi I and II dark brown and strongly bowed (concave dorsally) for much of length (especially leg I), thinner distally but not obviously flattened. Spination: representative leg spination: Male (KS62169)—femur d1202, p0011; tibia d0010, v2102(2202), p1110, r1110; metatarsus d2102, v2021, p1001, r0101; II: femur d10202, p01011; tibia d0010, v2202, p1110, r1010(1110); metatarsus d2102, v2021, p1001, r0101; III: femur d1202, p0111; patella d101; tibia d1010, v122(112), p1010, r1010; metatarsus d2102, v2021, p1001, r0101; IV: femur

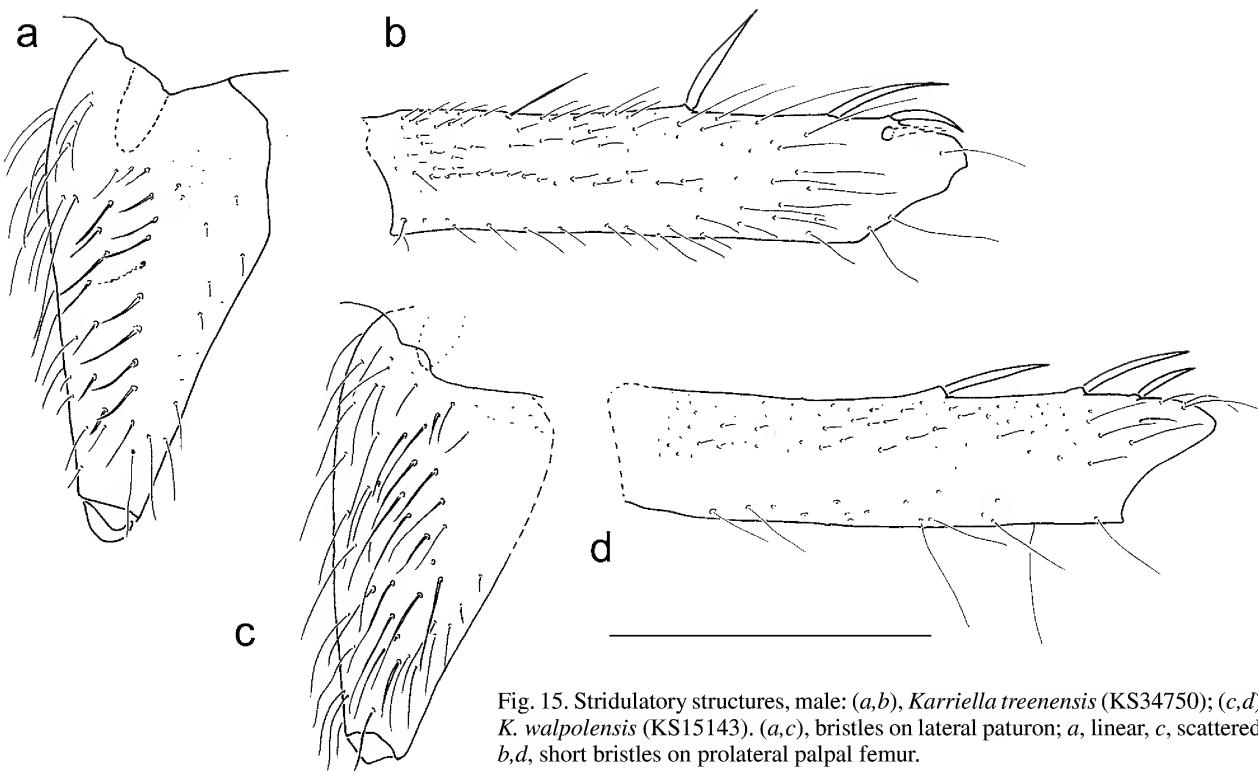


Fig. 15. Stridulatory structures, male: (a,b), *Karriella treenensis* (KS34750); (c,d), *K. walpolensis* (KS15143). (a,c), bristles on lateral paturon; a, linear, c, scattered; b,d, short bristles on prolateral palpal femur.

d112(20102), p001(01011); patella d001; tibia d1010, v1102, p01010, r01010; metatarsus d200102, v020201, p011001, r000101. Female (KS79521)—I: femur d1202, p0111; tibia d0010, v222, p1110, r1110(1010); metatarsus d212, v221, p0101, r0101; II: femur d1202, p0111; tibia d0010, v222, p1110, r1010; metatarsus d2012, v221, p0101, r0101; III: femur d1202 p0101(0111); patella d101; tibia d1010, v112, p0110, r0110; metatarsus d2012, v221, p101, r011; IV: femur d1012, p001(0101); tibia d1010, v112, p01010, r01010; metatarsus d222, v221, p0101, r001.

**Male palp** (Figs 16a,b, 17a,b). Cymbium with a short digitiform apex with 3 bristle-like spines; retrolateral flange of moderate to large size. Bulb rounded. Tegular lobe retrobasal, small or indistinct, the sperm duct in two axial loops visible in ventral or retrolateral view. Embolus a tapering, curved spine resting in the deep marginal conductor groove. Conductor a modified, broad T-shape, with a thick stem directed prolaterally to anteriorly, the “T” margin with flange-like processes; a ventral conductor process (VCP) extends anteriorly across the embolus and conductor groove. Tegular window prolateral to basal, moderate size. MA small, unipartite, membranous and prolaterally placed. Tibia about as long as wide, with 3 strong prolateral bristles; with a short, blunt RVTA and a short or long RDTA. Patella about as long as wide with a dorsoapical bristle.

**Epigynum** (Figs 16c–e, 17c–e). Fossa divided by a median septum or an indistinct median ridge; septum or fossa margins may appear broken and irregular; posterior fossa floor or wall with a pair of shallow socket-like recesses; copulatory ducts open anterolaterally. Internal genitalia simple, with a pair of short copulatory ducts entering the spermathecae ventrolaterally; spermathecae globose, contiguous or subadjacent medially, placed just anterior to the epigastric groove.

**Included species.** *Elleguna major* n.sp., *E. minor* n.sp.

**Remarks.** The species included here occur sympatrically in the Eungella region. They show some marked differences in genitalic structure. However, both share the unique presence of a ventral conductor process on the male palp, and paired “sockets” in the posterior epigynal fossa (floor or wall) of females. Damage may be seen to the lateral margins (*E. major*) or the median septum (*E. minor*) of the epigynal fossa.

**Distribution.** From the Eungella NP region to the coastal Mt Dryander range, NE of Mackay, mid-eastern Queensland.

### *Elleguna major* n.sp.

Figs 8d, 16a–e

**Type material. Queensland:** HOLOTYPE: ♂, KS34765, lower slopes of Mt William, Dalrymple Heights near Eungella, 21°01'S 148°36'E, Apr. 1975, M. Gray & C. Horseman, in log, Rainforest Survey Site 15, notophyll evergreen vine forest. PARATYPES: ♀, KS57656, Eungella area, Snake Rd, 4.7 km NW Dalrymple Rd, 21°02'47"S 148°32'17"E, 20 Apr. 1998, G. Milledge; ♂, KS34585, Dalrymple Heights, 21°04'S 148°35'E, 9 Apr. 1975, M.R. Gray & C. Horseman, in roadside bank near Rainforest Survey Camp; ♀, KS57653, Eungella NP, Dalrymple Rd, 1.3 km NE Snake Rd junction, 21°04'S 148°35'E, 18 Apr. 1998, G. Milledge; ♀, KS57654, as KS57653 but 1.7 km; 2 ♂♂, 4 ♀♀, KS83622–7, data as for holotype.

**Diagnosis.** Differs from *E. minor* as follows: male palp with a large ventral conductor process, a basally angled and apically elongated embolus, and a large RDTA; epigynal fossa indistinctly divided by a weak median ridge and lateral fossa margins extended inwards as thin “flanges”.

### Description

**Male** (holotype). BL 6.65, CL 3.22 (range 3.10–3.39), CW 2.33, CapW 1.22, EGW 0.88, LL 0.43, LW 0.43, SL 1.59, SW 1.35. Legs: 1423 (I: 15.58; II: 13.17; III: 11.58; IV: 14.25); ratio tibia I length:CW = 1:0.66. Male palp (Fig. 16a,b). Bulb

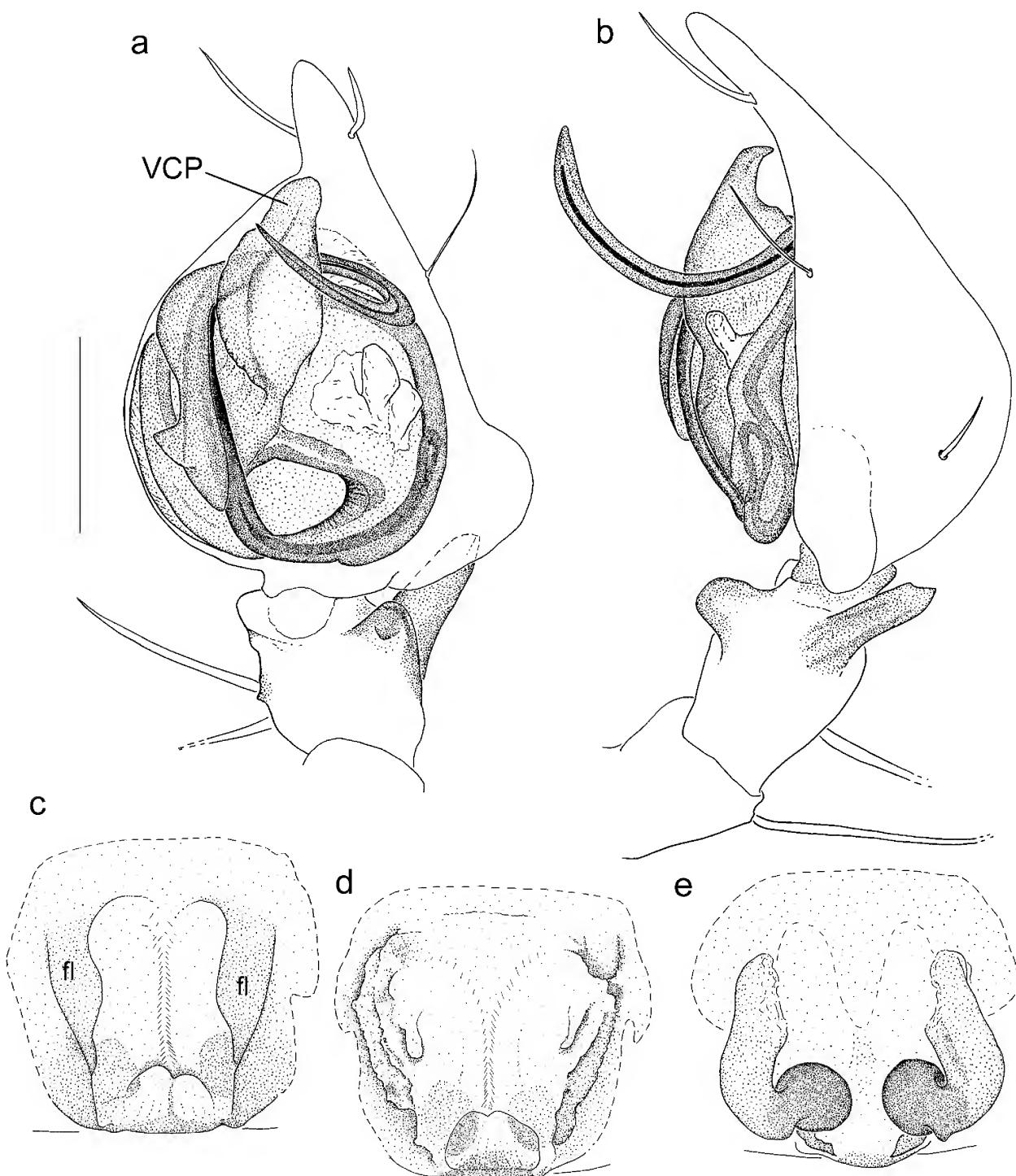


Fig. 16. *Elleguna major*. (a,b), male palp (holotype): a, ventral; b, retrolateral. (c–e), epigynum: c, ventral, fl = flange (KS57656); d, ventral, flanges broken (KS83624); e, dorsal—internal genitalia (KS83624). Scale lines 0.5 mm: upper, a,b; lower, c–e.

with a reduced, indistinct TL, with a tightly looped sperm duct visible retrolaterally. Embolus a long, curved spine, thick and strongly angled basally just before entering the conductor groove, then tapering and slender distally. Prolateral limb of conductor wide with a triangular flange; retrolateral limb extended as a long, translucent, curved spine supporting the elongate embolus and making a loose loop around the ventral conductor process. VCP very large with a thickened base. TW basal. MA surrounded by a collar-like membranous area. RDTA a robust, ventrally concave, tapering process.

**Female** (KS57656). BL 8.37, CL 4.00 (range 3.22–4.00), CW 2.53, CapW 1.88, EGW 1.16, LL 0.61, LW 0.59, SL 1.80, SW 1.51. Legs: 1423 (I: 14.33; II: 12.25; III: 10.58; IV: 13.00); ratio tibia I length:CW = 1:0.69. Epigynum (Fig. 16c–e). Fossa longer than wide, weakly divided by a median ridge; anterolateral fossa margins extended as thin, flange-like laminae ("fl" in Fig. 16c) over the anterolateral fossa floor and copulatory openings (these flanges may be broken off—Fig. 16d); posterior fossa floor with a pair of adjacent "socket-like" recesses. Copulatory duct openings anterola-

teral, widely separated. Internal genitalia. Copulatory ducts very short, of moderate width; spermathecae small.

**Distribution.** Known only from Eungella NP area, mid-eastern Queensland.

**Etymology.** The species name refers to the large size of the male palpal ventral conductor process.

### *Elleguna minor* n.sp.

Figs 8d, 17a–e

**Type material. Queensland:** HOLOTYPE: ♂, S74216 (QM), Crediton, c. 21°16'S 148°32'E, R. Kohout & V. Davies, 14–21 Apr. 1975, sheet web (running underneath). PARATYPES: ♀, KS79572, 2 ♂♂, KS79581–2, ♂, KS57652, Eungella NP, Broken River rainforest walk, 0.5 km from carpark, 21°10'S 148°30'E, 18 Apr. 1998, G. Milledge, sheet webs on banks of pathway; 3 ♀♀, S62169 (QM), data as holotype; ♂, S62165 (QM), Mt Dryander summit, 20°15'S 148°33'E, 740 m, 24 Apr. 1979, G.B. Monteith, rainforest, berlesate, moss on rocks & trees; ♀, S62167 (QM), Mt Dryander, 20°15'S 148°33'E, 700–800 m, 21 Nov. 1992, Monteith, Thompson, Cook & Janetzki.

**Other material. Queensland:** ♂, 2 ♀♀, S62168 (QM), Eungella NP, c. 21°10'S 148°30'E, 9 Nov. 1991, R. Raven, P. Lawson, night coll.; ♀, S62164 (QM), Crediton, Eungella, 21°11'S 148°33'E, 750 m, 17 Nov. 1992, Monteith, Thompson, Cook & Janetzki; ♂, S27427 (QM), Mt Dryander, 20°15'S 148°33'E, 650 m, 21 Nov. 1992–mid Apr. 1993, D. Cook & G.B. Monteith, RF intercept & pitfalls; 7 ♀♀, S62170 (QM), Finch Hatton, c. 21°06'S 148°37'E, 7–14 Apr. 1975, R. Kohout, V. Davies, L. Myberg, running on underside of sheet webs with retreat in rotting wood or bank.

**Diagnosis.** Differs from *E. major* as follows: male palp with a small ventral conductor process; semicircular embolus; short RDTA; MA often with a sclerotized spot; epigynal fossa divided by a definite septum.

### Description

**Male (holotype).** BL 7.27, CL 3.71(range 3.35–3.96), CW 3.02, CapW 1.43, EGW 0.98, LL 0.51, LW 0.49, SL 1.71, SW 1.47. Legs: 1423 (I: 16.25; II: 14.08; III: 12.33; IV: 15.67); ratio tibia I length:CW = 1:0.79. Male palp (Fig. 17a,b). Cymbial flange large. Bulb with a small, retrobasal TL, the looped sperm duct visible ventrally. Embolus an evenly curved, semicircular spine. TW prolateral-basal. VCP a short, apically rounded plate. Curved conductor margin with two low, flange-like processes; retrolateral limb of conductor divided into a dorsal spine-like process and a ventral tapering, spatulate process, grooved for the embolus; both processes curve retroventrally. Membrane MA often with a small, sclerotized spot. RDTA short, with subterminal cusp.

**Female (KS79572).** BL 8.08, CL 3.92, CW 2.50, CapW 1.67, EGW 1.08, LL 0.56, LW 0.53, SL 1.71, SW 1.43. Legs: 1423 (I: 13.25; II: 11.08; III: 9.83; IV: 12.17); ratio tibia I length:CW = 1:0.75. Epigynum (Fig. 17c–e). Fossa divided by a septum with a pair of shallow recessed “sockets” in the adjacent posterior walls. Copulatory duct openings anterolaterally placed. Internal genitalia. Copulatory ducts short, about as wide as spermathecae.

**Comments.** The septum dividing the epigynal fossa is variable in width. Some thinner septa may be broken off towards the posterior end.

**Distribution.** Eungella NP area to Mt Dryander, mid-eastern Queensland.

**Etymology.** The species name refers to the small size of male palpal ventral conductor process.

### *Asmea* n.gen.

**Type species.** *Asmea akrikensis* n.sp.

**Etymology.** The generic name refers to the 1965 Australian Star Mountains Expedition to Papua New Guinea, during which several of the spiders described here were collected. The name is considered masculine.

**Diagnosis.** Palpal cymbium with large retrolateral flange; tegular lobe and base of embolus usually separated by a deep prolateral notch; MA bipartite, with erect membranous and erect to curved, weakly sclerotized processes; RVTA short, blunt, beak-like; RDTA typically long, keel-like. Epigynal fossa divided by a median septum; spermathecae separated, placed near the posterior fossa margin.

Separated from *Pillara* and *Borralla* by the presence of a short RVTA, from *Couranga*, *Karriella* and *Elleguna* by the simple, unmodified T-shaped conductor structure, and from *Jamberoo* by the MA shape and the keel-like RDTA.

**Description.** Medium-sized, cribellate spiders (CL 3.31–5.25). Similar to *Couranga* in general characters. AER strongly recurved with AME protuberant on low tubercle above concave clypeus. AME or PME largest (except *A. capella*).

Legs 1423. Superior claws long, slender. Male metatarsi I and II weakly to obviously bowed and flattened. Trochanters notched but deepest anteriorly. Spines: representative leg spination (*A. hayllari*): Male (SAM NN19579)—I: femur d1022, p0111; tibia d0010, v222, p1110, r1010; metatarsus d20102, v221, p0101, r0101. II: femur d10202, p01110; patella d00(1); tibia d0010, v222, p1110, r1010; metatarsus d20102, v221, p0101, r1010. III: femur d1202, p111; patella d101; tibia d1010, v222, p0110, r01010; metatarsus d20102, v221, p0101, r0101. IV: femur d20102, p0111; patella d101; tibia d1010, v222, p01010, r01010; metatarsus d222, v221, p0101, r001. Female (SAM BS1120)—I: femur d1202, p0111; tibia d00(10), v221(0), p1110, r1010; metatarsus d1012, v221, p0101, r0101. II: femur d1202, p0111; tibia d0010, v221(0), p1110, r1010; metatarsus d1012, v221, p0101, r0101. III: femur d1202, p0111; tibia d1010, v122, p110, r110; metatarsus d2102, v221, p0101, r0101. IV: femur d112, p001; patella d001; tibia d1010, v112, p1010, r01010; metatarsus d2012, v121(or 111), p0101, r001. Male palp (Fig. 18a,b). Cymbium with a large retrolateral flange and a coniform to digitiform apex with 2–3 bristle-like spines. Bulb subcircular to ovoid. Tegulum with a well differentiated, retrobasal TL. Sperm duct visible on the basal tegulum as a wide S-shaped loop. Embolus spiniform, curving in a semi-circle from its probasal tegular origin around the conductor margin. Conductor T-shaped, with a simple marginal groove; retrolateral limb tapering to a pointed tip that curves ventrad, clasping the distal embolus. Tegular window large, prolaterally placed. MA large, bipartite, both processes more or less laminate and erect—medial process unsclerotized; lateral process weakly sclerotized and either erect or curved. Tibia

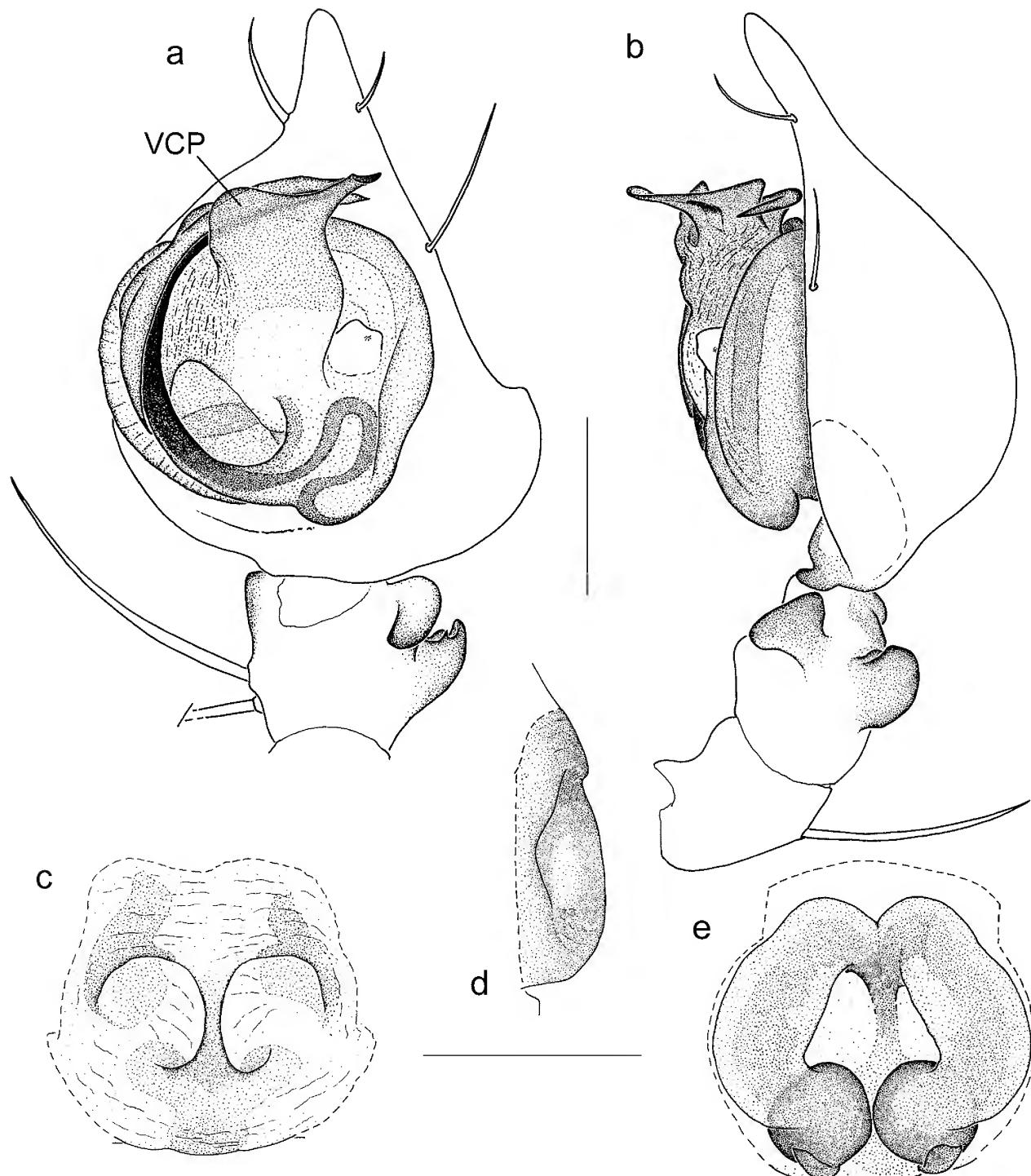


Fig. 17. *Elleguna minor*. (a,b), male palp (KS57652): a, ventral; b, retrolateral. (c–e), epigynum (KS79572): c, ventral; d, lateral; e, dorsal—internal genitalia. Scale lines 0.5 mm: upper, a,b; lower, c–e.

about as long as wide, with 2–3 strong prolateral bristles or spines and two distal apophyses: RVTA short, bluntly beak-like ventrally, widest in lateral view; RDTA typically a large, longitudinal, keel-like process (but “keel” short and notched in *A. hayllari*), attached along the retrodorsal tibia. Patella about as long as wide with a dorsal bristle. Epigynum (Fig. 19c–f). Fossa divided by a median septum. Copulatory

ducts very short, entering spermathecae anterodorsally; spermathecae ovoid, separated toward midline.

**Included species.** *Asmea akrikensis* n.sp., *A. hayllari* n.sp., *A. capella* n.sp., and *A. mullerensis* n.sp.

**Distribution.** Western Highlands of Papua New Guinea.

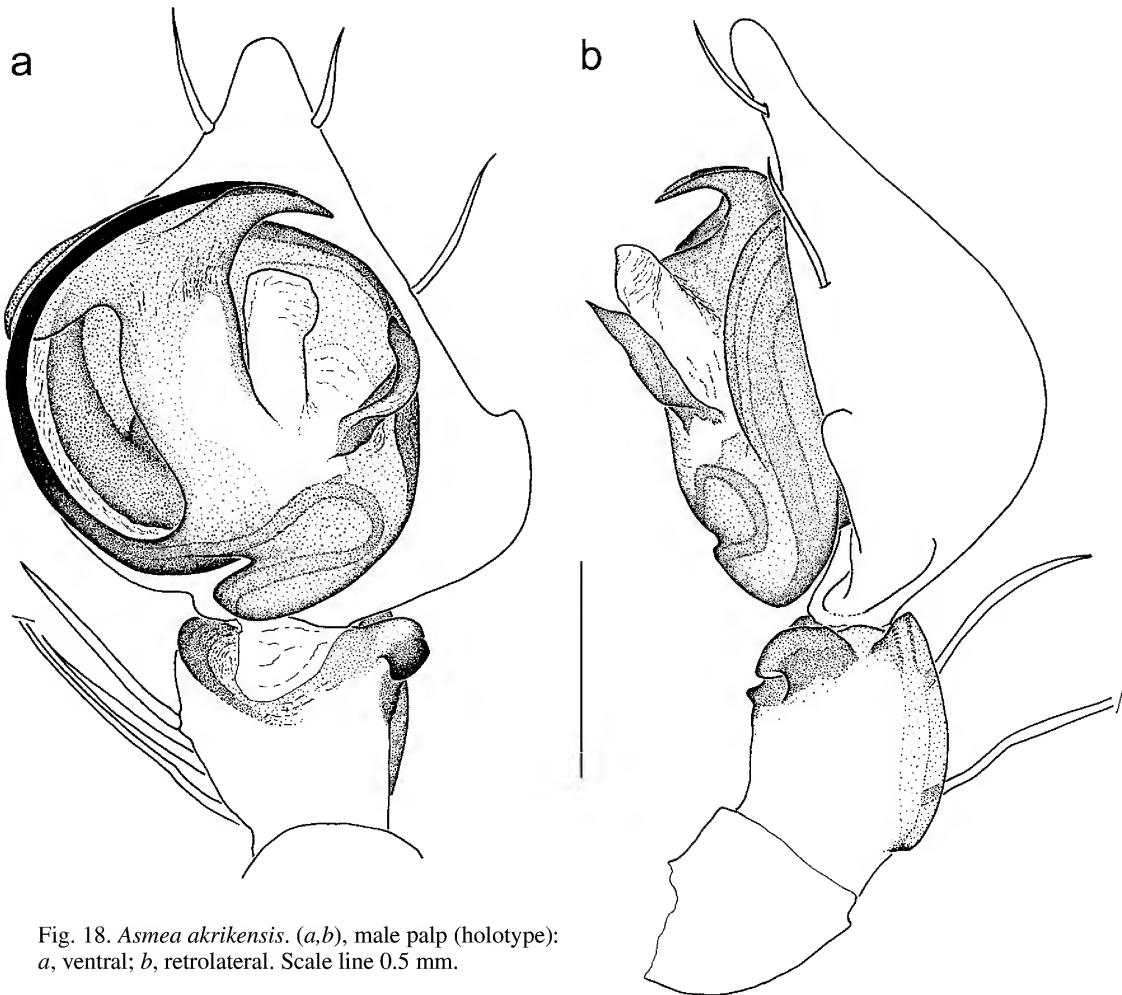


Fig. 18. *Asmea akrikensis*. (a,b), male palp (holotype): a, ventral; b, retrolateral. Scale line 0.5 mm.

### *Asmea akrikensis* n.sp.

Figs 8e, 18a,b

**Type material.** Papua New Guinea: Western Province: HOLOTYPE: ♂, KS45033, SE slopes of Mt Akrik, 15 km NW of Tabubil, 5°10'S 141°09'E, 14 Nov. 1993, R.B. Lachlan, 1625 m.

**Diagnosis.** Distinguished from males of other species by the wide separation of the two MA processes and the RDTA almost as long as the tibia.

### Description

**Male** (holotype). BL 6.73, CL 3.43, CW 2.65, CapW 1.47, EGW 0.98, LL 0.55, LW 0.49, SL 1.71, SW 1.47. Legs: 1423 (I: 13.14; II: 11.02 (RHS); III: 9.88; IV: 12.37); ratio tibia I length:CW = 1:0.82. AME≥PME>ALE≥PLE. Clypeus height ca 2× AME width. Metatarsi I and II dark brown and strongly sclerotized, bowed (dorsally concave) and dorsoventrally flattened. Male palp (Fig. 18a,b). Distal cymbium short, coniform. Apical margin of cymbial flange strongly offset. MA processes well separated, lateral process a flattened, twisted, weakly sclerotized spine. Deep indentation between TL and embolic base. RDTA a long keel, more than three-quarters length of tibia. Tibia with 3 strong prodorsal spine-like bristles.

**Female.** Unknown.

**Distribution.** Recorded only from the type locality.

**Etymology.** The species name refers to the type locality, Mt Akrik.

### *Asmea hayllari* n.sp.

Figs 8e, 19a-f

**Type material.** Papua New Guinea: Sandaum Province: HOLOTYPE: ♂, SAM NN19579, semi moss forest bordering the Nong-Ilam River systems N & E of Starr (sic) Mts, 6000'-7000', New Guinea 15-22 May 1965, T. Hayllar. (See comments on locality and coordinates below). PARATYPE: ♀, SAM BS1120, cave, Oksapmin, 4,800 ft, T.P.N.G., 22 May 1965, T. Hayllar (ASME). (See comments on locality data below)

**Diagnosis.** Differs from males of other species by the short, notched RDTA and smoothly rounded TL. Epigynal fossa with a narrow median septum.

### Description

**Male** (holotype). BL 7.96, CL 3.96, CW 2.78, CapW 1.59, EGW 1.12, LL 0.61, LW 0.57, SL 1.76, SW 1.55. Legs: 1423 (I: 18.25; II: 15.25; III: 12.08 [RHS, estimated, tarsus missing]; IV: 15.50); ratio tibia I length:CW = 1:0.61. AME>PME>ALE≥PLE. Clypeus height 1.75× AME width.

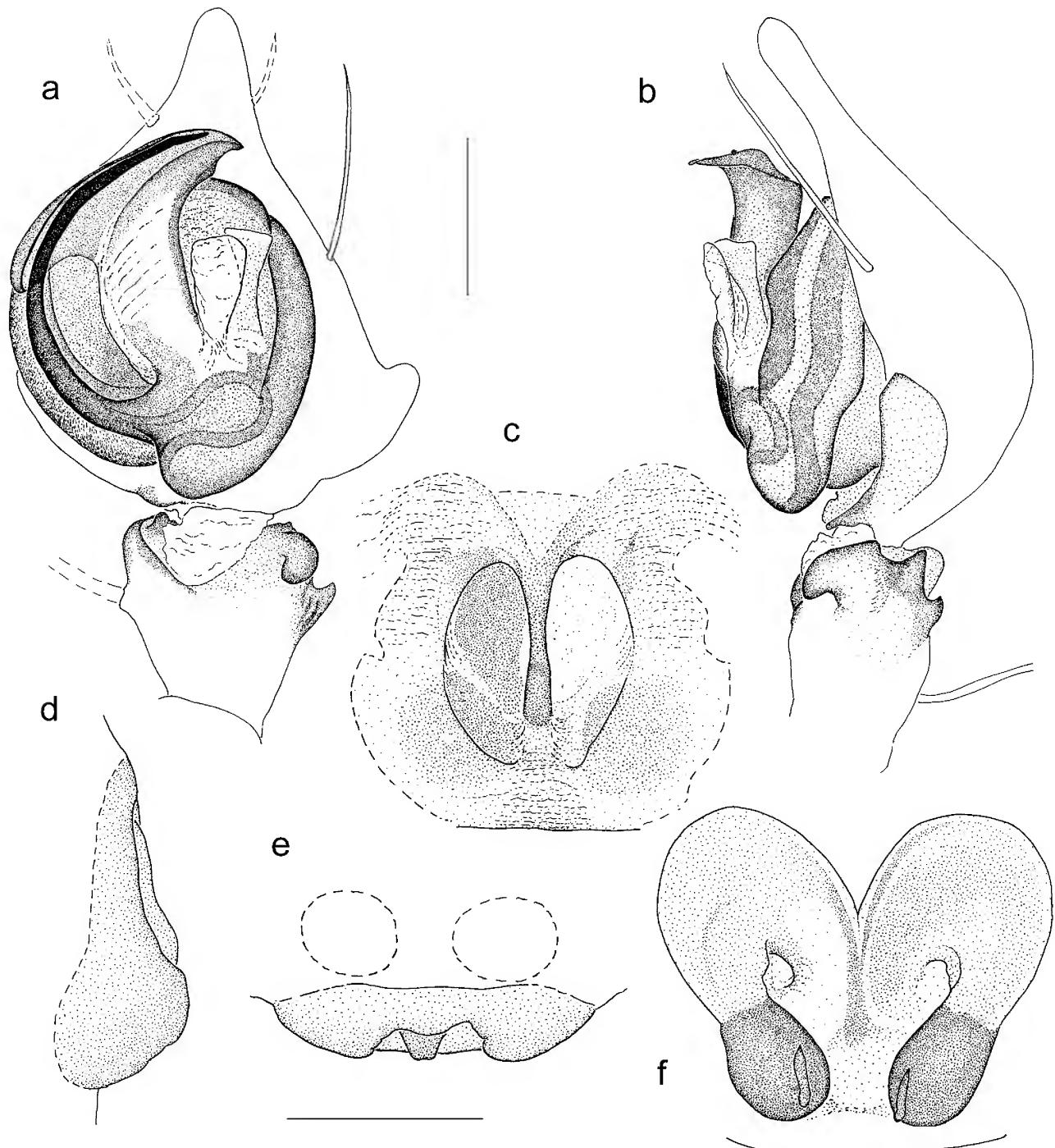


Fig. 19. *Asmea hayllari*. (a,b), male palp (holotype): a, ventral; b, retrolateral. (c-f), epigynum (SAM BS1120): c, ventral; d, lateral; e, posterior; f, dorsal—internal genitalia. Scale lines 0.5 mm: upper, a,b; lower, c-f.

Metatarsi I, II weakly bowed and flattened. Male palp (Fig. 19a,b). Distal cymbium short, conical. Apical margin of cymbial flange strongly offset. TL rounded, offset but not separated from base of embolus. MA processes adjacent, lateral process weakly sclerotized, widening and truncated apically. Tibia with 3 strong prodorsal bristles; RVTA laterally broad; RDTA keel short and notched.

**Female:** (BS1120). BL 10.17, CL 5.00, CW c. 3.00, CapW c. 2.33 (carapace damaged), EGW 1.43, LL 0.73, LW 0.73, SL 2.12, SW 1.92. Legs: 1423 (I: 20.08; II: 17.00; III: 14.33; IV: 17.33 [RHS]); ratio tibia I length:CW = 1:0.72.

PME>AME>ALE≈PLE. Clypeus height 3× AME width. Epigynum (Fig. 19c-f). Fossa longer than wide with narrow septum. Internal genitalia with very broad copulatory ducts and relatively small spermathecae (cf. *A. capella*).

**Distribution.** North-eastern Star Mountains, Sandaum Province, Papua New Guinea.

**Etymology.** The species is named in honour of Tom Hayllar, member of the Australian Star Mountains Expedition of 1965 and collector of the type material and other specimens of *Asmea*.

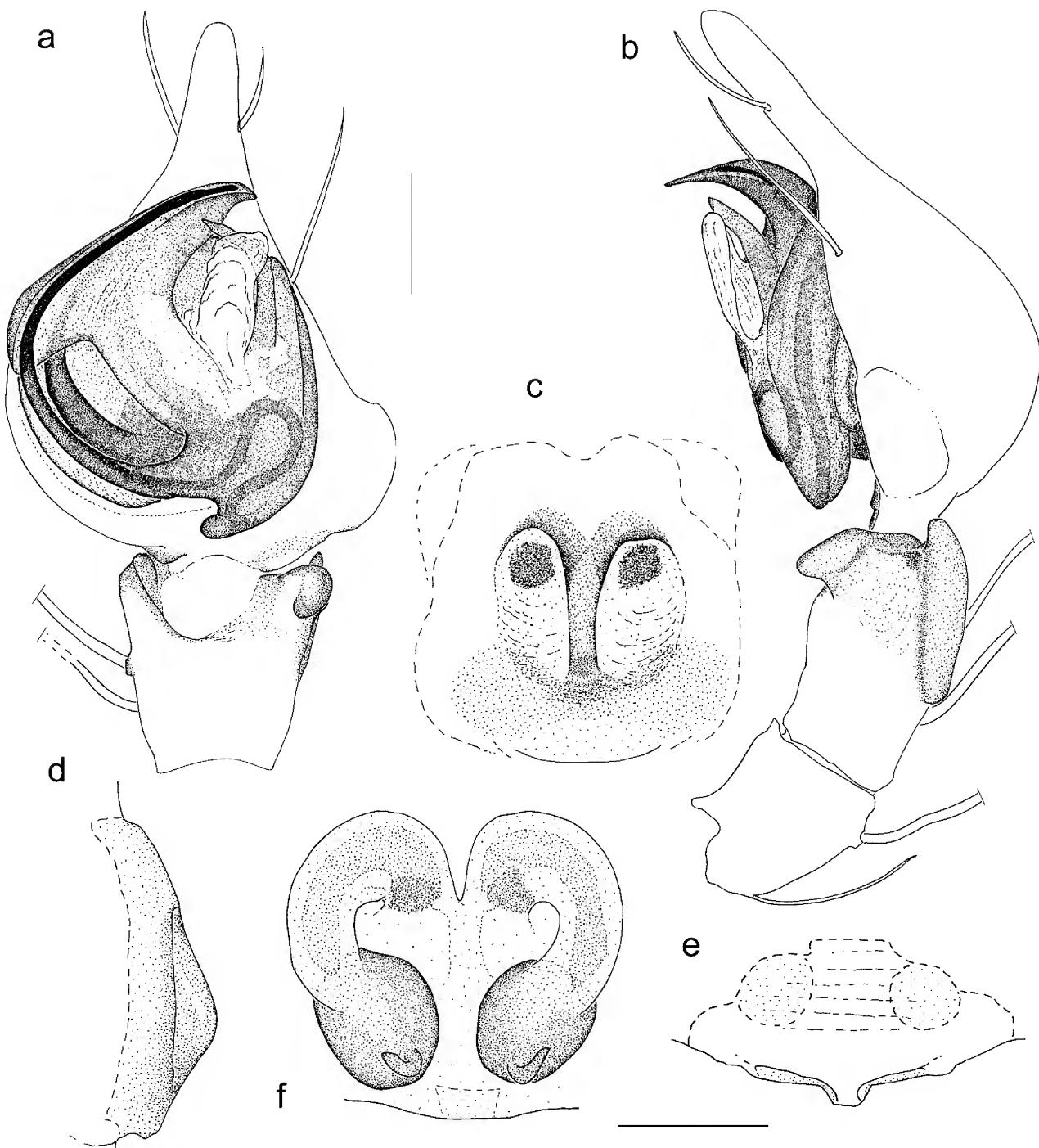


Fig. 20. *Asmea capella*. (a, b), male palp (SAM NN19576): a, ventral; b, retrolateral. (c–f), epigynum (holotype): c, ventral; d, lateral; e, posterior; f, dorsal—internal genitalia. Scale lines 0.5 mm: upper, a, b; lower, c–f.

**Comments on locality and coordinates.** *Paratype female locality*—the label data for this specimen gives the collection locality as “cave, Oksapmin”, a reference also found in the ASME diary notes provided by Tom Hayllar. Oksapmin is a village locality placed some 80 km east of Telefomin. However, all collecting done during the 1965 ASME took place in areas to the west of Telefomin, from which the expedition started and finished—the Oksapmin area to the east of Telefomin was neither sampled nor visited. Contemporaneous diary accounts and recollections record the paratype female as being collected at “a cave

near Oksapmin after leaving the Ilam River” (T. Hayllar, pers. comm.). All of this makes it likely that “Oksapmin” is actually a misspelling of Okapmin, a village placed west of Telefomin near the Ilam River. Accordingly, the coordinates for Okapmin are given as the approximate location for the female paratype in Fig. 8e ( $5^{\circ}07'S$   $141^{\circ}31'E$ ).

*Holotype male locality*—Hayllar’s ASME diary notes indicate that this specimen was collected about 1.5 days before the female during a seven day march along the Nong-Ilam River system toward “Oksapmin” (= Okapmin). This suggests that the male specimen was collected approxi-

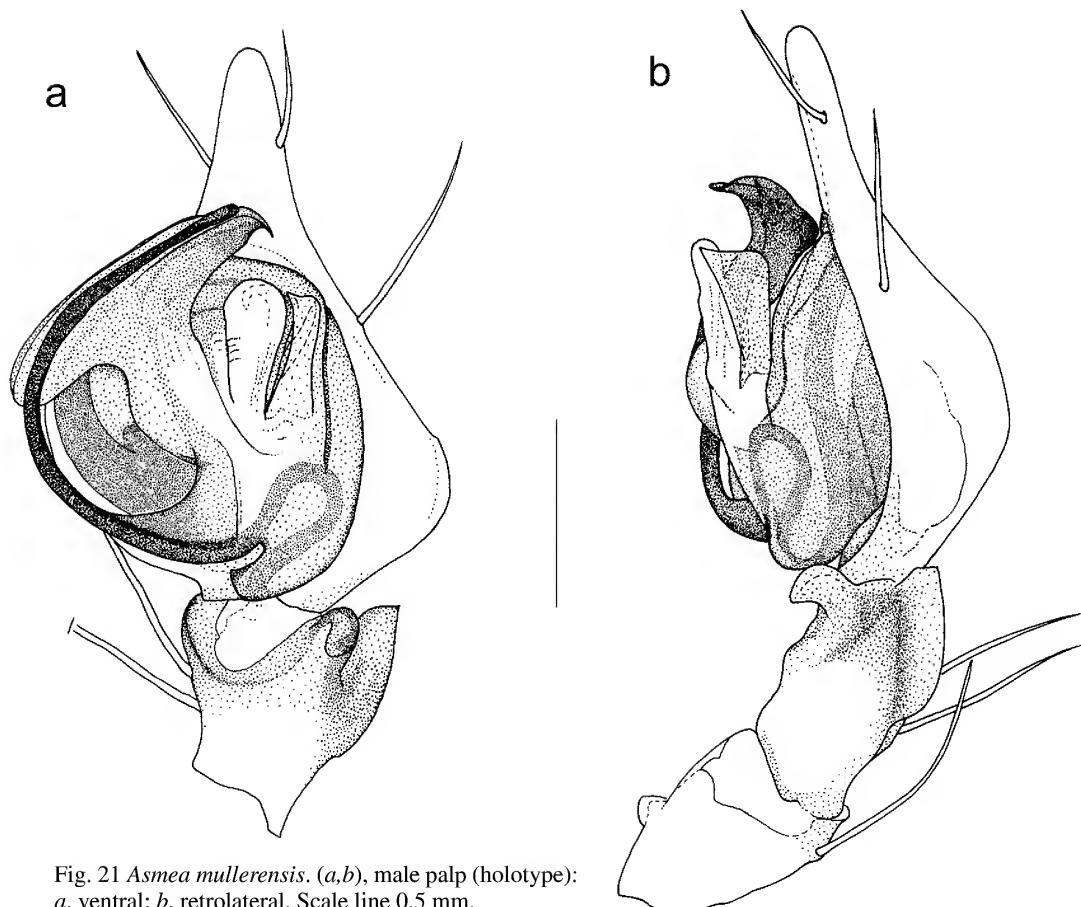


Fig. 21 *Asmea mullerensis*. (a,b), male palp (holotype): a, ventral; b, retrolateral. Scale line 0.5 mm.

mately 30 km from Okapmin. This assumption was used to approximate location coordinates for the male specimen ( $5^{\circ}04'S$   $141^{\circ}20'E$ ) in Fig. 8e. The relative proximity of these collecting sites provides additional support for the male-female conspecificity assumed here.

#### *Asmea capella* n.sp.

Figs 8e, 20a-f

**Type material.** Papua New Guinea: Western Province: HOLOTYPE: ♀, SAM BS1114, P.L. Cave, Star Mountains, T.P.N.G., ASME. (See comments on locality data below). PARATYPE: ♂, SAM NN19576, Star Mountains, New Cal. [sic], 1965. (See comments on locality data below)

**Diagnosis.** Separated from other species by the small AME; from *A. hayllari* by the wider epigynal septum and the smoothly keel-shaped RDTA, from *A. akrikensis* by the closely adjacent MA processes and from *A. mullerensis* by the “spiniform” and medially curved lateral MA process.

#### Description

**Female** (holotype). BL 11.08, CL 5.25, CW 3.67, CapW 2.37, EGW 1.39, LL 0.80, LW 1.00, SL 2.37, SW 2.16. Legs: long, 1423 (I: 26.17; II: 23.08; III: 20.25; IV: 24.67); ratio tibia I length:CW = 1:0.55. Eyes relatively small; AME smallest; PLE≈ALE>PME≥AME. Clypeus height 4× AME width. Epigynum (Fig. 20c-f). Fossa septum wider than in *A. hayllari*. Internal genitalia: copulatory ducts narrower and spermathecae larger than in *A. hayllari*.

**Male** (NN19576) (body partially collapsed, possibly due to drying). BL 7.96, CL 4.08, CW 2.98 (estimated), CapW 1.84 (estimated), EGW 1.16, LL 0.84, LW 0.73, SL 1.98, SW 1.82. Legs: long, 1423 (I: 27.17; II: 24.08; III: 20.42; IV: 25.17); ratio tibia I length:CW = 1:0.45 (estimated). Metatarsi I weakly bowed, II moderately bowed and weakly flattened. Eyes with AME and ALE smallest (AME probably reduced); PME≥PLE>AME≥ALE. Clypeus height 4× AME width. Male palp (Fig. 20a,b). Distal cymbium short, digitiform. Deep indentation between TL and embolic base. MA processes closely adjacent; lateral process weakly sclerotized and “spiniform”, curving behind the medial process. Tibia with 3 strong prodorsal bristles; RVTA laterally broad. RDTA a long keel, almost three-quarters length of tibia.

**Distribution.** Star Mountains, Western Province, Papua New Guinea.

**Etymology.** The specific name refers to Capella, a peak in the Star Mountains near the Plateau Limestone collecting locality.

**Comments on locality data.** It seems likely that the label data locality “New Cal.” given for the male specimen NN19576 is a subsequent mistranscription for “New Guinea”. This is because: (a) closely related males have been collected from the Star Mountains region in Papua New Guinea, including at least one by the ASME in 1965; and (b) there are no “Star Mountains” located in New Caledonia.

Consequently, it seems safe to assume that the spider is from the Star Mountains, Papua New Guinea, and we therefore treat the specimen as a male of this species.

The female type locality, P.L. Cave, refers to Plateau Limestone Cave (K1 or K1 sink) adjacent to the Dokfuma Base Camp near the Krom River, SE of Mt Capella (c. 5°01'S 141°08'E in Fig. 8e). This cave was visited by the ASME on 1 Apr. 1965 (T. Hayllar, pers. comm.). A female and 5 juveniles collected from P.L. Cave are present in the SAM collection. The presence in "K1 Sink" of "large spiders" is specifically mentioned in the expedition notes, but the sex or number of specimens collected is not. Both the male and female specimens described here are rather large and long legged, and have small AME (smallest in female) relative to the typically large AME size seen in other boraline species. This may represent evidence of adaptation to cave-dwelling, although only the female is definitely known to be associated with caves.

### *Asmea mullerensis* n.sp.

Figs 8e, 21a,b

**Type material.** Papua New Guinea: Southern Highlands Province: HOLOTYPE: ♂, KS571, Muller Range, scarp area, c. 5°34'S 142°25'E, 17 Aug. 1976, D. Rothery. (Locality coordinates approximated from maps and information in James *et al.*, 1977; James & Dyson, 1978)

**Diagnosis.** Separated from *A. akrikensis* by the closely adjacent MA processes and digitiform cymbium, from *A. hayllari* by the uniformly keel-shaped RDTA, and from *A. capella* by the erect and apically truncate retrolateral MA process.

### Description

**Male** (holotype). BL 6.58, CL 3.31, CW 2.29, CapW 1.35, EGW 1.03, LL 0.50, LW 0.50, SL 1.51, SW 1.39. Legs (legs 1 missing): probably (1)423. Metatarsi I missing, II weakly bowed and flattened. PME>AME>PLE>ALE. Clypeus height 1.75× AME width. Male palp (Fig. 21a,b). Distal cymbium short, digitiform. Cymbial flange not strongly offset from cymbium. Deep indentation between TL and embolic base. Bipartite MA processes approximated, lateral process an erect, moderately sclerotized and distally translucent lamina, truncate apically. Tibia with 3 prodorsal bristles; RVTA small; RDTA keel-like, about half length of tibia.

**Female:** Not known

**Distribution.** Recorded from the type locality only.

**Etymology.** The name refers to the Muller Range, the region from which this species was collected.

**ACKNOWLEDGMENTS.** For the loan of material we thank P. Lawless and O. Seeman (Queensland Museum), D. Hirst (South Australian Museum) and J. Waldeck (Western Australian Museum). Mr J. Noble donated material and provided accommodation at Jamberoo. Mr Tom Hayllar, a member of the 1965 Australian Star Mountains Expedition, provided valuable assistance with PNG collection data. This project was aided by funding to MRG through the New South Wales Biodiversity Strategy: Taxonomy Enhancement Research Grants. The line illustrations are by Helen Smith. The SEM images were made with the assistance of Sue Lindsay, Microscopy and Microanalysis Unit Manager, Australian Museum.

### References

Davies, V.T., 1995. A new spider genus (Araneae: Amaurobioidea: Amphinectidae) from the wet tropics of Australia. *Memoirs of the Queensland Museum* 38: 463–469.

Davies, V.T., 1999. *Carbinea*, a new spider genus from north Queensland, Australia (Araneae, Amaurobioidea, Kababininae). *Journal of Arachnology* 27: 25–36.  
[http://www.americanarachnology.org/JoA\\_Congress/JoA\\_v27\\_n1/arac\\_27\\_01\\_0025.pdf](http://www.americanarachnology.org/JoA_Congress/JoA_v27_n1/arac_27_01_0025.pdf)

Davies, V.T. & C. Lambkin, 2000. *Wabua*, a new spider genus (Araneae, Amaurobioidea, Kababininae) from north Queensland, Australia. *Memoirs of the Queensland Museum* 46: 231–249.

Davies, V.T. & C. Lambkin, 2001. A revision of *Procambridgea* Forster & Wilton, (Araneae: Amaurobioidea: Stiphidiidae). *Memoirs of the Queensland Museum* 46: 443–459.

Forster, R.R., & C.L. Wilton, 1973. The spiders of New Zealand. Part IV. *Otago Museum Bulletin* 4: 1–309.

Fromhage, L., & J.M. Schneider, 2006. Emasculation to plug up females: the significance of pedipalp damage in *Nephila fenes-trata*. *Behavioral Ecology* 17(3): 353–357.  
<http://dx.doi.org/10.1093/beheco/arj037>

Gray, M.R., 2005. A revision of the spider genus *Taurongia* (Araneae, Stiphidioidae) from south-eastern Australia. *Journal of Arachnology* 33: 490–500.  
<http://dx.doi.org/10.1636/04-122.1>

Gray, M.R., & H.M. Smith, 2002. *Therlinya*, a new genus of spiders from eastern Australia (Araneae: Amaurobioidea). *Records of the Australian Museum* 54(3): 293–312.  
<http://dx.doi.org/10.3853/j.0067-1975.54.2002.1368>

Gray, M.R., & H.M. Smith, 2004. The "striped" group of stiphidiid spiders: two new genera from northeastern New South Wales, Australia (Araneae: Stiphidiidae: Amaurobioidea). *Records of the Australian Museum* 56(1): 123–138.  
<http://dx.doi.org/10.3853/j.0067-1975.56.2004.1394>

Griswold, C.E., 1993. Investigations into the phylogeny of the lycosid spiders and their kin (Arachnida: Araneae: Lycosoidea). *Smithsonian Contributions to Zoology* 539: 1–39.

Griswold, C.E., J.A. Coddington, N.I. Platnick & R.R. Forster, 1999. Towards a phylogeny of entelegyne spiders (Araneae, Araneomorphae, Entelegynae). *Journal of Arachnology* 27: 53–63.

Griswold, C.E., M.J. Ramirez, J.A. Coddington & N.I. Platnick, 2005. Atlas of phylogenetic data for entelegyne spiders (Araneae: Araneomorphae: Entelegynae) with comments on their phylogeny. *Proceedings of the Californian Academy of Sciences* 56, Supplement II: 1–324.

Homann, H., 1971. Die Augen die Araneae: Anatomie, Ontogenese und Bedeutung für die Systematik (Cheliceraata, Arachnida). *Zeitschrift für Morphologie der Tiere* 69: 201–272.  
<http://dx.doi.org/10.1007/BF00277623>

James, J., R. King & N. Montgomery, 1977. Muller '76. *Niugini Caver* 5: 103–127.

James, J.M., & H.J. Dyson, (eds), 1978. Caves and karst of the Muller Range. *Atea* 78. Sydney: Australia.

Levi, H.W., 1970. The *ravilla* group of the orbweaver genus *Eriophora* in North America (Araneae: Araneidae). *Psyche* 77: 280–307.

Platnick, N.I., 2007. *The World Spider Catalogue*, version 7.5. American Museum of Natural History  
<http://research.amnh.org/entomology/spiders/catalog/index.html>

Raven, R.J., & K.S. Stumkat, 2005. Revisions of Australian ground-hunting spiders: II. Zoropsidae (Lycosoidea: Araneae). *Memoirs of the Queensland Museum* 50(2): 347–423.

Suhm, M., K. Thaler & G. Alberti, 1996. Glands in the male palpal organ and the origin of the mating plug in *Amaurobius* species (Araneae: Amaurobiidae). *Zoologische Anzeiger* 234: 191–199.

Manuscript submitted 16 February 2007, revised 09 August 2007, and accepted 15 October 2007.

Associate Editor: D.J. Bickel.

# Trapdoor Spiders of the Genus *Misgolas* (Mygalomorphae: Idiopidae) from Eastern New South Wales, With Notes on Genetic Variation

GRAHAM WISHART<sup>1</sup>\* AND DAVID M. ROWELL<sup>2</sup>

<sup>1</sup> Research Associate, Australian Museum, 6 College Street, Sydney NSW 2010, Australia  
gwishart@tpg.com.au

<sup>2</sup> School of Botany and Zoology, The Australian National University, Canberra ACT 0200, Australia  
David.Rowell@anu.edu.au

**ABSTRACT.** This paper reports on species of the idiopid trapdoor spider genus *Misgolas* Karsch, 1878 found in the Central Coast, Newcastle and Lower Mid-North Coast Regions of New South Wales, Australia. They comprise twenty-two new species: *M. mudfordae* n.sp., *M. thompsonae* n.sp., *M. tarnawskiae* n.sp., *M. dougweiri* n.sp., *M. maxhicksi* n.sp., *M. campbelli* n.sp., *M. yorkmainae* n.sp., *M. helensmithae* n.sp., *M. weigelorum* n.sp., *M. taiti* n.sp., *M. sydjordanae* n.sp., *M. davidwilsoni* n.sp., *M. crawfordorum* n.sp., *M. watsonorum* n.sp., *M. raveni* n.sp., *M. fredcoylei* n.sp., *M. billsheari* n.sp., *M. baehrae* n.sp., *M. macei* n.sp., *M. grayi* n.sp., *M. browningi* n.sp. and *M. linklateri* n.sp. Three species dealt with in Wishart (2006) are also included in the region covered by this work: *M. melancholicus*, *M. villosus* and *M. gracilis*. A key for males of the species within the regions is presented, as well as distribution maps and comments on taxonomy and natural history. Also included is one new species from Bondi, an eastern suburb of Sydney—*M. milledgei*.

The status of the *Misgolas* species dealt with by Wishart (2006) is clarified. An outline of the intervention of molecular work necessitated by need to match otherwise undiagnosable species with conspecific males is discussed. *Misgolas hubbardi* is placed in the synonymy of *M. rapax* as it shows no significant morphological differences in the females of the two species, nor significant molecular divergence. *Dyarcyops ionthus*, *Arbanitis montanus* and *A. chisholmi* are removed from the synonymy of *M. rapax*; and *A. fuscipes* is removed from the synonymy of *M. villosus*. *A. montanus* is given full species status. *Dyarcyops ionthus*, *A. chisholmi* and *A. fuscipes* are species incertae sedis.

WISHART, GRAHAM, & DAVID M. ROWELL, 2008. Trapdoor Spiders of the genus *Misgolas* (Mygalomorphae: Idiopidae) from eastern New South Wales, with notes on genetic variation. *Records of the Australian Museum* 60(1): 45–86.

Since 1992 one of us (GW) have been accessing the Australian Museum's collection of mygalomorph spiders of the trapdoor spider genus *Misgolas* presently in excess of 2,200 specimens, for the most part collected from New South Wales. Of these the female and juvenile specimens

were generally not considered for species status because of the paucity of useful identifying characters. Of the males (about 1,300) photographic records of palp and bulb were kept to demonstrate interspecific variations in morphology of those organs. A similar exercise examining

*Misgolas* spider specimens held at the Queensland Museum, Brisbane, indicated a similar pattern of numerous species. From this work it seemed probable that different species of *Misgolas* trapdoor spiders found in New South Wales and Queensland would be in excess of one hundred. Presently there are 19 recognized species from New South Wales, six from Queensland, two from Tasmania and one from South Australia. This work introduces to this list a further 23 species from New South Wales.

Early in 1993 an extensive pitfall trapping collection of invertebrates throughout northern New South Wales was carried out by Dr M. Gray and Dr G. Cassis. This collection alone accounted for possibly 33 of the New South Wales *Misgolas* species estimated number. Because of the propensity for different species of male *Misgolas* spiders to wander in search of a female partner at different specific times of year (Wishart, 1993) and the geographic constraints on collecting programmes it is possible that collections made throughout a whole year and from more localities would yield many more species new to science.

This paper is the second in a geographical series detailing the distribution of spiders of the genus *Misgolas* Karsch, 1878 throughout New South Wales. The first, (Wishart, 2006) reported on species located in the Sydney Region. This work identifies species collected from the region immediately north of the Sydney Region, from the Hawkesbury River north to the 31°30'S parallel approximating Port Macquarie and the Hastings River and east of longitude 151°E to the coast (Fig. 24A). Further papers recording species from the Illawarra and South Coast, Far North Coast and the Western slopes of New South Wales are in preparation.

Three *Misgolas* species dealt with by Wishart (2006) have distributions extending from the Sydney Region into the region covered by this work (Fig. 24B). One of us (GW) would anticipate that the passing of time will show each of them to consist of a number of different species. These spiders are presently treated as: *Misgolas villosus* (Rainbow, 1914), in Wishart, 2006, p. 3, *M. gracilis* (Rainbow & Pulleine, 1918), in Wishart, 2006, p. 7 and *M. melancholicus* (Rainbow & Pulleine, 1918), in Wishart, 2006, p. 10.

## Material and methods

Follows that of Wishart (2006). All specimens are deposited in the Australian Museum, Sydney. Measuring points are taken from Coyle (1971).

Whilst at rest the bulb of the male palpal organ is folded into the ventral excavation of the palpal tibia. Usually the brown sclerous convex side is uppermost against the tibia cavity and is considered here to be the dorsal surface. The weakly chitinous flange is retrolaterally situated on the basal part of the embolus. The configuration of the embolus of the male bulb (e.g., straight or bent) is described from dorsal aspect. Measurements and counts refer to the characters on the right side of the specimen and where provided data for the left side is given in brackets. Notation of spines is taken from Forster & Wilton (1968).

## Terminology

Terminology follows Wishart (2006): *ALE*, anterior lateral eyes; *AM*, Australian Museum, Sydney (specimens listed under accession numbers prefixed KS are deposited in the AM); *AME*, anterior median eyes; *d*, dorsal; *DTA*, distal tibial apophysis, a small, often hooked, apical apophysis positioned retrodorsally on tibia of male palp (usually present); *GW*, G. Wishart; *pd*, prodorsal; *pl*, prolateral; *PLE*, posterior lateral eyes; *PME*, posterior median eyes; *PMS*, posterior median spinnerets; *pv*, proventral; *rd*, retrodorsal; *rl*, retrolateral; *RTA*, retroventral tibial apophysis, a prominent apophysis projecting generally forward from c. midway on tibia of male palp; *rv*, retroventral; *TEM*, tibial excavation mound, a usually pallid mound within tibial excavation, of variable prominence, prolaterally adjacent to or contiguous with RTA; *TET*, tibial excavation texture, a textured area of a series of raised transverse lines within palpal tibial excavation and which encroaches upon TEM; *v*, ventral; width/length ratio—ratio of maximum width to length of ocular area; only rarely, and then only marginally, is this greater than 2 (Main, 1985).

## Key to males of species in the genus *Misgolas* from the New South Wales Central Coast south of Port Macquarie to Hawkesbury River

1	Embolus tip sinuous from dorsal aspect (Fig. 1B) .....	2
—	Embolus tip straight or with simple bend, not sinuous (Fig. 7B) .....	7
2	Embolic dorsal apophysis remote from embolus swollen tip (Fig. 1C) .....	3
—	Embolic apophysis absent or placed on swollen tip .....	5
3	Metatarsi I and II with bilateral small clusters of spines near distal edges (Fig. 1E–H) .....	<i>M. mudfordae</i>
—	Small clusters of spines absent from metatarsi I and II .....	4
4	Tarsi I and II without spines .....	<i>M. thompsonae</i>
—	Tarsi II (only) with retroventral row of small spines adjacent to scopula (Fig. 3G) .....	<i>M. tarnawskiae</i>
5	Embolic apophysis absent .....	<i>M. dougweiri</i>
—	Embolic apophysis on swollen tip (Fig. 5C) .....	6

6 Small dorsal embolic apophysis on swollen tip (Fig. 5C) ..... *M. maxhicksi*  
 — Acutely pointed prodorsal embolic apophysis near tip (Fig. 6B) ..... *M. campbelli*

7 Tarsi I and II with bilateral rows of small spines adjacent to scopula; metatarsus I and II with bilateral small clusters of spines near distal edges (Fig. 7E–H) ..... 8  
 — Small spines adjacent to scopula on tarsi I and II and spine clusters on metatarsi I and II absent ..... 9

8 Distal tibial apophysis massive; proximal half retrolateral tibial apophysis abruptly swollen (Fig. 7A) ..... *M. yorkmainae*  
 — Distal tibial apophysis small; retrolateral tibial apophysis digitate (Fig. 8A) ..... *M. helensmithae*

9 Distal tibial apophysis hooked (Fig. 9A) ..... 10  
 — Distal tibial apophysis straight or absent ..... 13

10 Cymbium dorsal surface with pallid bristles, spines absent (Fig. 9D) ..... *M. weigelorum*  
 — Cymbium dorsal surface with spines ..... 11

11 Embolic apophysis positioned as figured (Fig. 10B) ..... *M. taiti*  
 — Embolic dorsal apophysis remote from tip or apophysis absent ..... 12

12 Embolic dorsal apophysis present (Wishart, 2006, fig. 5B,C) ..... *M. melancholicus*  
 — Embolic apophysis absent (Wishart, 2006, fig. 1B,C) ..... *M. villosus*

13 Embolic apophysis present or flange with one large fold ..... 14  
 — Embolic apophysis absent ..... 18

14 Embolic flange with one large fold (Wishart, 2006, fig. 3B,C) ..... *M. gracilis*  
 — Embolic apophysis present ..... 15

15 Embolic dorsal apophysis subdistal (Fig. 11C). Second apophysis absent ..... *M. sydjordanae*  
 — Embolic apophyses prodorsal or prolateral, not dorsal unless a second apophysis ..... 16

16 Venter pale with brown speckles in 2–3 transverse bands (Fig. 12F) ..... *M. davidwilsoni*  
 — Venter entirely brown or black ..... 17

17 Venter entirely black (Fig. 13D). Embolic prolateral apophysis subdistal. Small second, dorsal, embolic apophysis remote from tip (Fig. 13B,C). Retrolateral tibial apophysis digitate (Fig. 13A) ..... *M. crawfordorum*  
 — Venter entirely brown (Fig. 14D). Embolic prolateral apophysis subdistal. Second embolic apophysis absent (Fig. 14B,C). RTA swollen, not digitate (Fig. 14A) ..... *M. watsonorum*

18 Distal tibial apophysis absent (Fig. 15A) ..... *M. raveni*  
 — Distal tibial apophysis present, not hooked ..... 19

19 Embolic retrolateral flange distal margin sharply convexly curved folding under embolus as if twisted (Figs 16B, 17B, 18B, 19B) ..... 20  
 — Embolic retrolateral flange margin straight or gently curved (Figs 20B, 21B, 22B) ..... 23

20 Distal tibial apophysis inclined downwards, not horizontal (Figs 16A, 17A) ..... 21  
 — Distal tibial apophysis horizontal, projecting forward (Fig. 18A) ..... 22

21 Distal tibial apophysis small; retrolateral tibial apophysis straight (Fig. 16A) ..... *M. fredcoylei*  
 — Distal tibial apophysis large; retrolateral tibial apophysis basally bent (Fig. 17A) ..... *M. billsheari*

22 Distal tibial apophysis digitate; retrolateral tibial apophysis digitate, (Fig. 18A) ..... *M. baehrae*  
 — Distal tibial apophysis not digitate; retrolateral tibial apophysis thickset, inclined downwards (Fig. 19A) ..... *M. macei*

23 Retrolateral tibial apophysis digitate (Fig. 20A) ..... *M. grayi*  
 — Retrolateral tibial apophysis short, stout (Figs 21A, 22A) ..... 24

24 Distal tibial apophysis large; cymbium dorsal spines absent (Fig. 21A) ..... *M. browningi*  
 — Distal tibial apophysis small digitate; cymbium dorsal spines present (Fig. 22A,E) ..... *M. linklateri*

The male of *M. chisholmi* (Hickman, 1933) is unknown.

### ***Misgolas mudfordae* n.sp.**

Figs 1A–J, 24A.

**Type material.** HOLOTYPE ♂, AM KS50037, Bateau Bay, N.S.W., (33°22'S 151°29'E), 14 July 1997, Lyn Abra.

**Diagnosis.** In male: medium sized brown spider, carapace length c. 7, retrodorsal surface of metatarsi IV without spines (Fig. 1I); venter pale with sparse even distribution of small dark brown speckles (Fig. 1D). Bilateral clusters of spines (c. 6–13 spines per cluster) adjacent to distal edges of metatarsi I and II (Fig. 1E–H). Palpal bulb (Fig. 1B,C) embolic flange with 5 prominent folds and c. 3–4 minor folds; embolus tip sinuous from dorsal aspect (Fig. 1B), appearing swollen from lateral aspect; embolus dorsal apophysis placed midway remote from swollen tip (Fig. 1C). Conformation of palp as figured (Fig. 1A). Female unknown.

### Description

**Male holotype** (Fig. 1A–J). **Size.** Carapace length 6.96, width 5.58. Abdomen length 7.35, width 4.51. **Colour.** In alcohol chelicerae, carapace and limbs tan, unicolourous. Faint brown smudge (Wishart, 1992) or “burnt decoration” (Raven & Wishart, 2005) on rl surface of patella I, absent from remaining limbs. Abdomen dorsum brown with c. 5 pallid transverse chevrons. Venter pallid with sparse even distribution of small dark brown speckles (Fig. 1D). **Carapace.** Edge fringed with black bristles which encroach onto posterior quarter of post foveal surface. Fine setae with golden sheen and small black bristles on caput. Row of 8 black bristles, and remains of 3 others, on caput arch; 8 bristles between PME; 13 bristles on clypeus. Weakly chitinous area absent from pleuron membrane below clypeus. Fovea width 1.30, straight with recurved edges; posterior wall centrally divided by shallow pitted intrusion. **Eyes.** Placed on mound; area immediately adjacent to eyes black. Anterior width 1.24, posterior width 1.11, length 0.67, width length ratio 1.85. Line joining posterior edges of ALE transects anterior quarter of AME. Posterior row straight in front, recurved behind. **Chelicerae.** Rastellum first row 5(7) spines; few smaller

spines retreat along anteroental edge. Fang groove with 8(10) large promarginal teeth and 9(8) small retromarginal/intermediate row teeth. Intercheliceral tumescence raised, pallid, with dense cover of dark prostrate setae. **Labium.** Bulbous, length 0.74, width 1.12. Labio-sternal suture narrow, deep, continuous. **Maxillae** c. 56(52) squat, spindle shaped anteroental cuspules, none surmounted by a fine hair. **Sternum.** Length 3.99, width 2.92. Anterior and mid pair sigilla small, round, submarginal; posterior pair larger, ovate, two diameters from margin. **Legs.** Tibia I with distal bifid apophysis; distal process with 2(2) short pointed spines, proximal process with 3(3) long pointed spines.

	palp	I	II	III	IV
femur	3.81	6.69	6.01	4.67	6.26
patella	1.78	3.32	2.89	2.33	3.01
tibia	3.56	4.97	4.18	2.76	5.59
metatarsus	—	5.03	4.45	3.86	5.59
tarsus	1.78	2.95	2.76	2.49	3.00
total	10.93	22.96	20.29	16.11	23.45

**Palp** (Fig. 1A). Cymbium with c. 60 long skewer-like, cylindrical, dark brown spines inclined forward c. 45° to cymbium axis, distributed on distal half of d surface. RTA not swollen; covered with d and rd short blunt-pointed spines which become pointed and continue along rv edge of tibial excavation; c. 9 longer pointed spines suspended from short, straight DTA. TEM pallid, adjacent to RTA. TET distinct on anterior and pl sides of TEM. **Bulb** (Fig. 1B,C). Embolic rl flange with 5 prominent folds and c. 3–4 minor folds; margin gently convexly curved, distal edge folds under embolus. Embolus tip sinuous from d aspect, appearing swollen from lateral aspect. Embolic d apophysis placed midway, remote from swollen tip, terminating a small ridge. **Scopula.** Complete on tarsi I and II; weak and incomplete on metatarsi I and II; absent on legs III and IV. **Trichobothria.** Palp: tarsi 6, tibia pd 5, rd 5. Leg I: tarsi 13, metatarsi 11, tibia pd 6, rd 6. Leg II: tarsi 13, metatarsi 11, tibia pd 6, rd 6. Leg III: tarsi 9, metatarsi 9, tibia pd 6, rd 6. Leg IV: tarsi 11, metatarsi 12, tibia pd 7, rd 7. **Leg spination.** Leg I (Fig. 1E,F): tarsi bilateral rows small spines adjacent to scopula pv 13, rv19; metatarsi v 010, pl distal cluster of 13, rl distal cluster of 11; tibia v 012. Leg II (Fig. 1G,H): tarsi bilateral

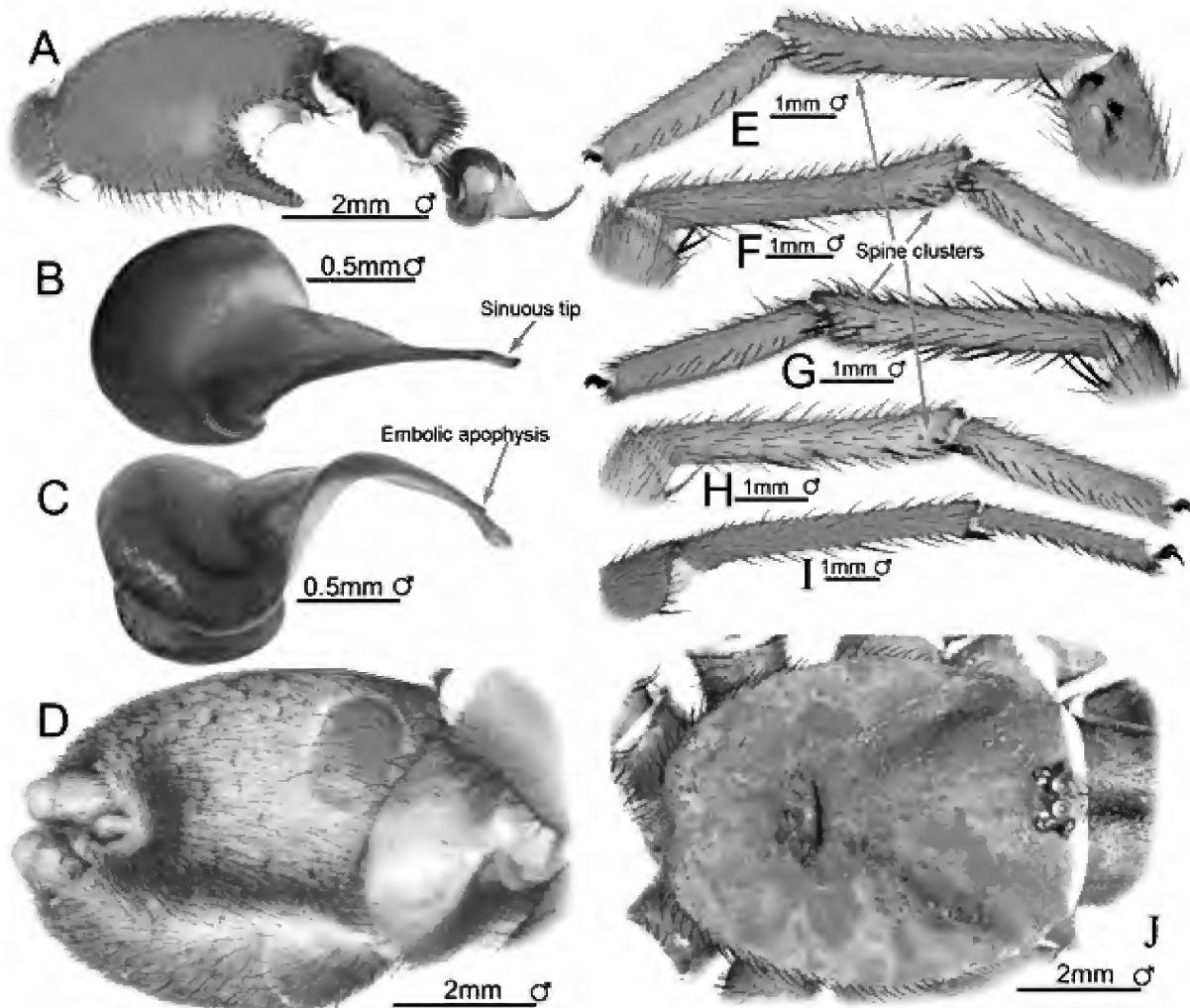


Fig. 1. *Misgolas mudfordae* n.sp. A–J ♂, holotype AM KS50037: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), venter. (E, F), right leg I: E, prolateral; F, retrolateral. (G, H), right leg II: G, prolateral; H, retrolateral. (I), right leg IV retrolateral. (J), carapace.

rows small spines adjacent to scopula pv 16, rv 25; metatarsi v 0121100, pl distal cluster of 9, rl distal cluster of 6; tibia v 0114. Leg III: tarsi v c. 40; metatarsi v c. 15, d 02220; tibia v 0113, pd 0110, rd 00110; patella pd 6. Leg IV: (Fig. 1I): tarsi v c. 44; metatarsi v c. 11; tibia v 0112. *Abdomen*. Misshapen. Dorsum with cover of long brown erect bristles, under story of fine hairs continuing over venter. Venter densely covered with small, prostrate brown bristles.

**Remarks.** The species may be confused with *M. thompsonae* n.sp. and *M. tarnawskiae* n.sp. but is separable from them by reference to conformation of RTA, presence of bilateral distal spine clusters on metatarsus I and II and both tarsi I and II with bilateral rows of small spines adjacent to scopula.

**Etymology.** The species is named in recognition of the valuable voluntary assistance given by Pam Mudford to the arachnology section of the Australian Museum, Sydney.

**Distribution and natural history.** (Fig. 24A) The spider is known only from the type locality, the town of Bateau Bay, N.S.W. The burrow is unknown.

#### *Misgolas thompsonae* n.sp.

Figs 2A–H, 24A.

**Type material.** HOLOTYPE ♂, AM KS36705, Chichester State Forest (RM), Berrico Road, about 2 km north of intersection with Kunungra Road (32°05'53"S 151°45'43"E), 1023 m, 4 Feb.–9 Apr. 1993, pit fall trap site 35BR, M. Gray, G. Cassis.

**Diagnosis.** In male: medium sized tan spiders, carapace length c. 6.45; retrodorsal surface of metatarsi IV without spines; venter pallid with few short dark brown maculations in 2–3 weak transverse bands (Fig. 2D). Spines absent on tarsi I and II. Bilateral small clusters of spines absent or weak on distal edges of metatarsi I and II (Figs 2E–H). Palpal bulb with retrolateral embolic flange with c. 4 prominent folds and 2–3 minor folds; embolus tip sinuous from dorsal aspect (Fig. 2B), appears swollen from lateral aspect by thin flange suspended from tip (Fig. 2C); embolic dorsal apophysis placed midway remote from tip (Fig. 2C). Conformation of palp as figured (Fig. 2A). Female not known.

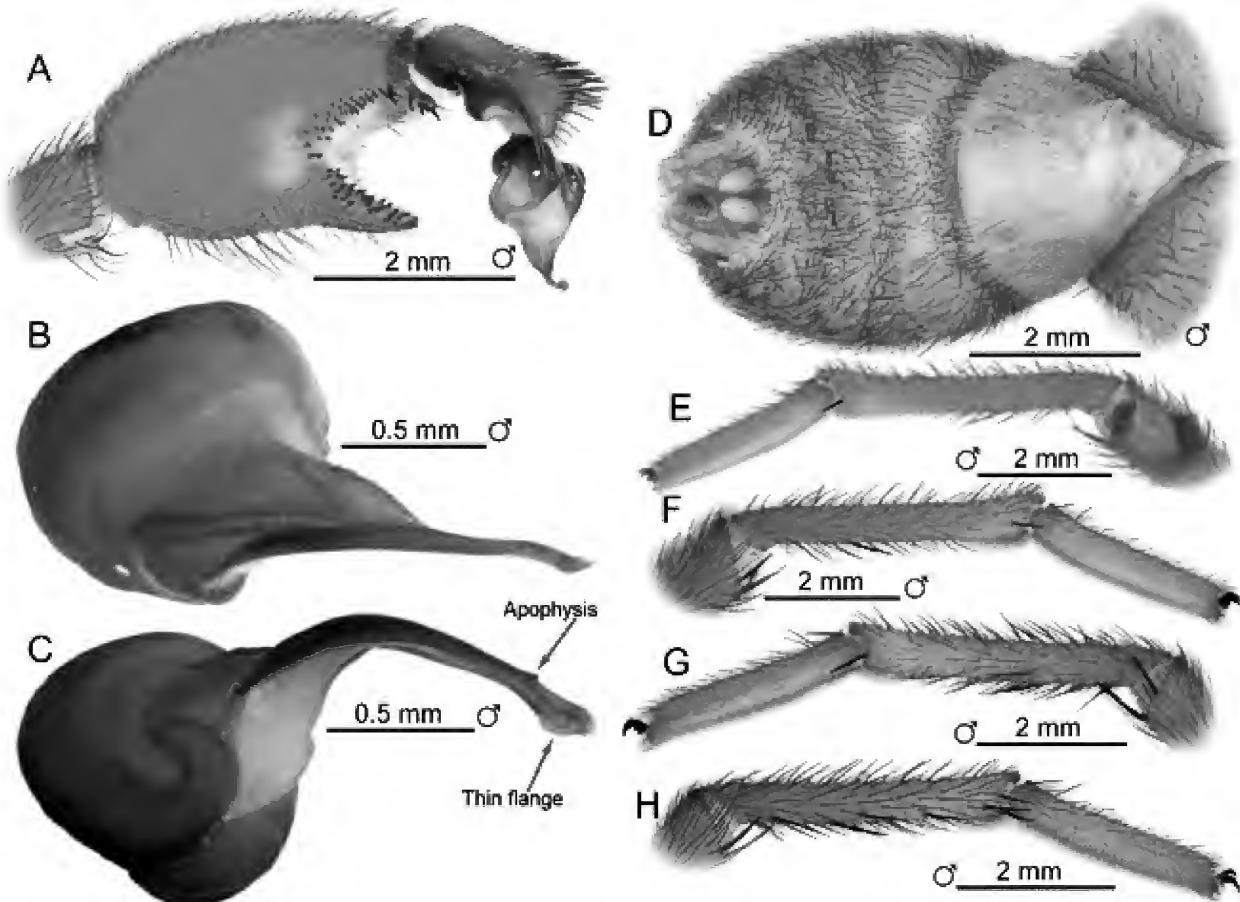


Fig. 2. *Misgolas thompsonae* n.sp. A–H ♂, holotype AM KS36705: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), venter. (E, F), right leg I: E, prolateral; F, retrolateral. (G, H), right leg II: G, prolateral; H, retrolateral.

### Description

**Male holotype** (Fig. 2A–H). **Size.** Carapace length 6.45, width 5.16. Abdomen length 5.65, width 3.93. **Colour.** In alcohol carapace, legs, palps and chelicerae mid tan; darker brown smudges absent. Few sparse pallid hairs on caput, absent elsewhere. Abdomen dorsum pallid mottled with dark brown. Venter pallid with few small dark brown maculations mostly arranged in transverse band (Fig. 2D). **Carapace.** Edge fringed with black bristles which extend onto post foveal surface; some smaller bristles mostly associated with stria. Line of 7 median bristles anteriorly inclined on caput arch. Group of 6 bristles between PME; group of 7 bristles on clypeus. Area extending onto pleuron below clypeus narrow, weakly chitinous, with one seta. Fovea width 1.31, straight, posterior wall centrally divided by small pitted intrusion. **Eyes.** Raised on mound. Areas adjacent to eyes, anterior to ALE excepted, black. Anterior width 1.12, posterior width 1.02, length 0.64, width/length ratio 1.75. Line joining posterior edge of ALE transects anterior quarter of AME. Posterior row straight in front, recurved behind. **Chelicerae.** Rastellum first row 6(6) strong spines; many smaller spines behind retreating back along pd chelicerae edge. Intercheliceral tumescence shapeless, raised on low pallid mound; with cover of prostrate brown setae. Fang groove with 10(9) promarginal teeth and 10(7) smaller retromarginal/intermediate row teeth. **Labium.** Bulbous, length 0.69, width 1.08. Labio-sternal suture broad, narrowed medially, continuous. **Maxillae** c. 50(50) short,

squat, anteroental cuspules, many with terminal fine hair. **Sternum.** Length 3.43, width 2.46. Sigilla small round; first pair submarginal, mid pair separated from margin by c. 1.5 times their own diameter, third pair by twice their diameter. **Legs.** Left leg I missing. Tibia I with distal bifid apophysis; distal process with 2 short spines with blunt points, proximal process with 2 long pointed spines.

	palp	I	II	III	IV
femur	3.56	6.20	5.64	4.42	6.20
patella	1.72	2.82	2.70	2.09	2.82
tibia	3.44	4.42	4.05	2.64	5.28
metatarsus	—	4.61	3.99	3.43	5.34
tarsus	1.72	2.70	2.52	2.21	2.82
total	10.44	20.75	18.90	14.79	22.46

**Palp** (Fig. 2A). Cymbium with c. 50 long skewer-like pointed spines, anteriorly inclined c. 45° to cymbium axis, distributed over distal third of d surface and distal two-thirds of pd surface. RTA broad without swellings, d and rd surface covered with 35 large squat pointed spines; c. 36 similar spines reduced in size continue on rv edge of tibial excavation; c. 12 long spines suspended from straight DTA. TEM large pallid, adjacent to RTA. TET present on pl face of TEM and v surface of tibial excavation. **Bulb.** Embolic rl flange with 4 prominent and c. 3 minor folds; margin gently convexly curved, distal edge folds under embolus. Embolus tip sinuous from d aspect (Fig. 2B), appears swollen from lateral aspect by thin v flange suspended from tip (Fig. 2C).

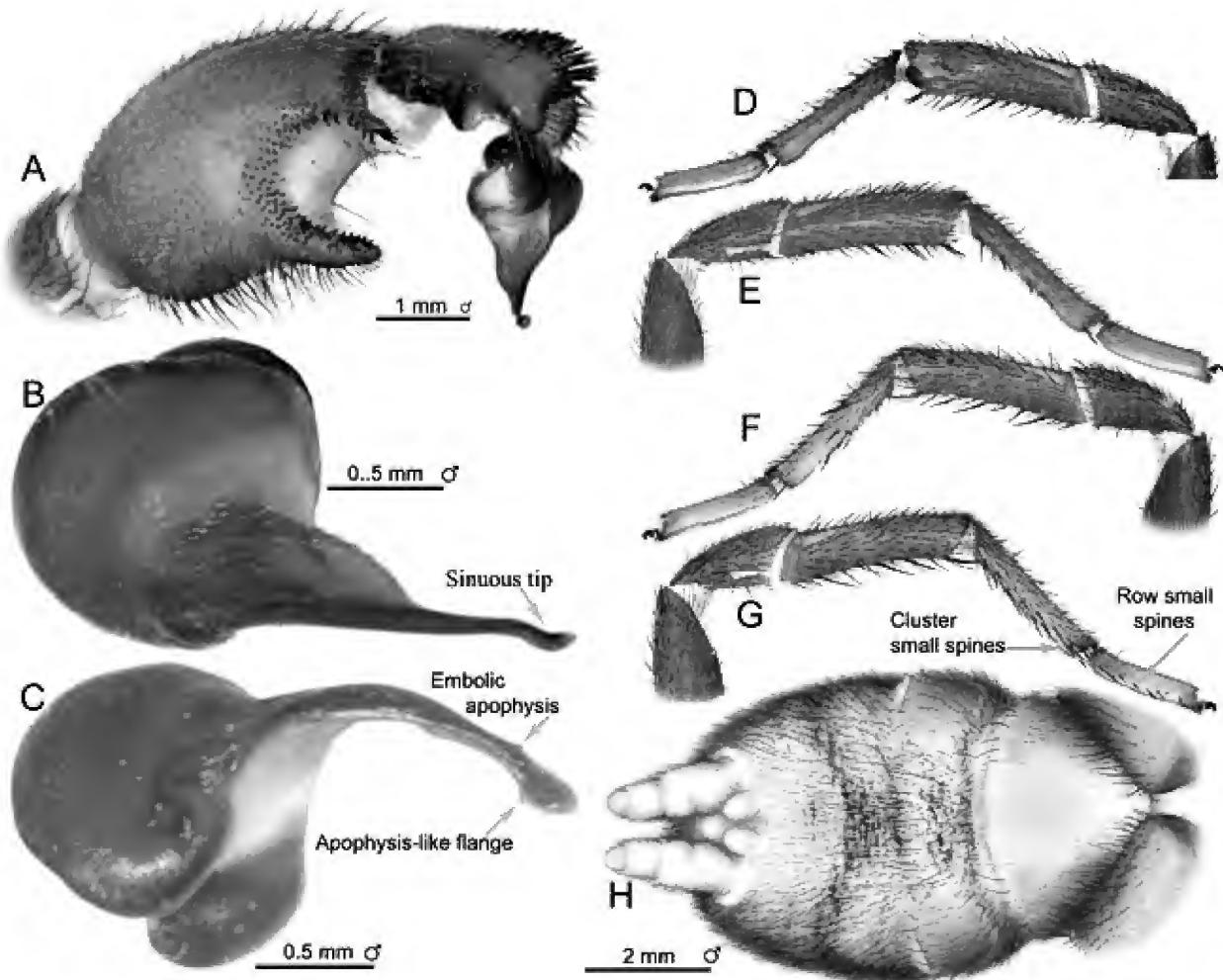


Fig. 3. *Misgolas tarnawskiae* n.sp. A–H ♂, holotype AM KS92879: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D,E), right leg I: D, prolateral; E, retrolateral. (F,G), right leg II: F, prolateral; G, retrolateral. (H), venter.

Embolus apophysis placed c. midway, remote from tip, terminating small ridge. *Scopula*. Dense and complete on tarsi I and II; weak and incomplete on metatarsi I and II and tarsi III; absent on metatarsi III and leg IV. *Trichobothria*. Palp: tarsi 9, tibia pd 5, rd 5; Leg I: Tarsi 11, metatarsi 14, tibia pd 6, rd 6; Leg II: tarsi 10, metatarsi 11, tibia pd 5, rd 5; Leg III: tarsi 9, metatarsi 9, tibia pd 5, rd 6; Leg IV: tarsi 10, metatarsi 13, tibia pd 7, rd 6. *Leg spination*. Leg I (Fig. 2E,F): metatarsi v 0010010, pv 01; tibia v 0112. Leg II (Fig. 2G,H): metatarsi pv 0101(0101), rv 0111112(0011111); tibia v 0113. Leg III: tarsi v 12 scattered; metatarsi v 9 scattered, d 002020; tibia v 0113, pl 0110, rl 011; patella pd 7. Leg IV: tarsi v 16 scattered; metatarsi v 10 scattered; tibia v 8 scattered. *Abdomen*. Dorsum with cover of erect long brown bristles. Sides flanked with softer prostrate hairs; prostrate bristles on venter with understory of fine setae.

**Remarks.** The species may be confused with *M. mudfordae* n.sp. and *M. tarnawskiae* n.sp. but is separable from them by reference to conformation of RTA, absence of distal spine clusters on metatarsi I and spines absent on tarsi I and II.

**Etymology.** The species is named in recognition of Judy Thompson, one time technical officer in the arachnology section of the Australian Museum, Sydney.

**Distribution and natural history.** (Fig. 24A) This species is known only from Cape Hawke near Forster, NSW. The burrow is unknown.

#### *Misgolas tarnawskiae* n.sp.

Figs 3A–H, 24A

**Type material.** HOLOTYPE ♂, AM KS92879, 21 Carmona Drive, Cape Hawke, nr Forster (32°12'59"S 152°33'02"E), 1 Mar. 2006, Ken Watson, recovered from in-ground pool. PARATYPE ♂: AM KS92878, 20 Mar. 2006, other details as for holotype AM KS92879.

**Diagnosis.** In male: large brown spider, carapace length c. 8–9, retrodorsal surface metatarsi IV without spines; venter pattern as figured (Fig. 3H), proximal limb segments inclusive of patella dark brown; remaining limb segments progressively lighter (Fig. 3D–G). Row of small retroventral spines adjacent to scopula of tarsi II (Fig. 3G), proventral and retroventral rows absent on tarsi I and proventral row absent on tarsi II (Fig. 3D–F). Cluster of c. 5–8 retrolateral spines adjacent to distal edge of metatarsi II (Fig. 3G), nil or few spines near distal prolateral edge metatarsi II and distal lateral edges metatarsi I (Fig. 3D–F). Palpal bulb

(Fig. 3B,C) embolic flange with 4 prominent folds and c. 3–5 minor folds; embolus tip sinuous from dorsal aspect, appears swollen from lateral aspect by small thin ventral apophysis-like flange suspended from proximal edge of tip swelling (Fig. 3C); embolic dorsal apophysis placed remote from swollen tip (Fig. 3C). Conformation of palp as figured (Fig. 3A). Female not known.

## Description

**Male holotype** (Fig. 3A–H). *Size*. Carapace length 8.43, width 6.66. Abdomen length 7.94, width 5.39. *Colour*. In alcohol chelicerae, carapace, dorsal abdomen and proximal limb segments inclusive of patella dark brown. Remaining limb segments progressively lighter; dark brown smudges absent. Abdomen dorsum with 6 pallid transverse chevrons. Venter pallid with dark brown maculations most dense as central transverse band and median band extending from epigastric furrow to the transverse band. *Carapace*. Edge fringed with black bristles that encroach onto posterior half of post foveal surface. Setae with gold sheen sparse, most concentrated along stria anterior borders. Row of 12 seta/bristle sockets on caput arch; 11 dark brown bristles between PME; 12 bristles and c. 10 weak pallid bristles on clypeus. Setae absent on weakly chitinous area extending onto pleuron membrane below clypeus. Fovea width 1.79, straight with recurved edges; posterior wall centrally divided by minute pitted intrusion. *Eyes*. Placed on mound; area immediately adjacent to eyes black. Anterior width 1.36, posterior width 1.33, length 0.79, width/length ratio 1.72. Line joining posterior edges of ALE bisects AME. Posterior row slightly recurved in front, recurved behind. *Chelicerae*. Rastellum first row 7(6) spines, second row 6(7). Fang groove with 9(9) large promarginal teeth and 19(19) small retromarginal/intermediate row teeth. Intercheliceral tumescence raised, pallid with cover of prostrate dark setae. *Labium*. Bulbous, length 0.92, width 1.36. Labio-sternal suture broad, continuous. *Maxillae* c. 44(46) short, spindle shaped anteroventral cuspules, one surmounted by a fine hair. *Sternum*. Length 4.51, width 3.36. Anterior and mid pair sigilla small, round, c. their own diameter from margin; posterior pair larger, ovate, c. their own length from margin. *Legs*. Tibia I with distal bifid apophysis; distal process with 2(2) short pointed spines, proximal process with 3(3) longer pointed spines.

	palp	I	II	III	IV
femur	4.48	7.31	6.63	5.53	7.25
patella	2.15	3.87	3.62	2.89	3.75
tibia	4.05	4.97	4.54	3.13	6.20
metatarsus	—	5.10	4.67	4.18	6.08
tarsus	2.03	2.89	2.76	2.58	3.13
total	12.71	24.14	22.22	18.31	26.41

*Palp* (Fig. 3A). Cymbium with c. 46 long, skewer-like, dark brown spines inclined forward c. 45° to cymbium axis, distributed on distal half of d surface. RTA digitate, not swollen; covered with d and rd short pointed spines which continue uninterrupted along rv edge of tibial excavation; c. 13 longer curved attenuate spines suspended from straight DTA. TEM pallid, adjacent to RTA. TET distinct on anterior and pl sides of TEM. *Bulb* (Fig. 3B,C). Embolic rl flange with 4 long folds and c. 3–5 minor folds; margin gently convexly curved. Embolus tip sinuous from d aspect, appears swollen

from lateral aspect by small, thin apophysis-like flange is suspended from proximal edge of tip swelling; minute embolic d apophysis placed remote from swollen tip.

*Scopula*. Complete on tarsi I and II; incomplete on metatarsi I, weak and incomplete on metatarsi II; absent on legs III and IV. *Trichobothria*. Palp: tarsi 8, tibia pd 6, rd 6. Leg I: tarsi 12, metatarsi 14, tibia pd 7, rd 7. Leg II: tarsi 11, metatarsi 13, tibia pd 7, rd 6. Leg III: tarsi 11, metatarsi 9, tibia pd 6, rd 6. Leg IV: tarsi 11, metatarsi 12, tibia pd 7, rd 7. *Leg spination*. Leg I (Fig. 3D,E): metatarsi v 02, rv 111101, pl 010; tibia v 010112. Leg II (Fig. 3F,G): tarsi rv row of 11 small spines adjacent to scopula; metatarsi v 01111, pv 011, rv 011111, rl distal cluster of 8, pd 010; tibia v 011112, pl 01, pd 0010. Leg III: tarsi v c. 56; metatarsi v c. 17, pd 012220, rd 000111; tibia v 0113, pd 0110, rd 00110; patella pd 9. Leg IV: tarsi v c. 42; metatarsi v 17; tibia v 021102. *Abdomen*. Dorsum with cover of long brown erect bristles; understory of fine hairs which continue bilaterally extending over venter; venter densely covered with prostrate brown bristles.

**Remarks.** The species may be confused with *M. mudfordae* n.sp. and *M. thompsonae* n.sp. but is separable from them by reference to conformation of RTA, absence of bilateral spine clusters on metatarsus I and spines absent on tarsi I.

**Etymology.** The species is named in recognition of Jaynia Tarnawski, technical officer, Australian Museum, Sydney.

**Distribution and natural history.** (Fig. 24A) This species is known only from the type locality, Cape Hawke near Forster, N.S.W. and is sympatric with *M. watsonorum* n.sp. The burrow is unknown.

## *Misgolas dougweiri* n.sp.

Figs 4A–H, 24A

**Type material.** HOLOTYPE M, AM KS50006, Killarney Vale (33°22'S 151°28'E), 25 May 1997, Lyn Abra. PARATYPES ♂♂: AM KS44411 (damaged condition), Dora Creek nr Gosford (33°05'S 151°30'E), 25 May 1996, Lyn Abra; AM KS49383, Mannerling Park (33°12'S 151°34'E), 24 Apr. 1997, Lyn Abra; AM KS69961, Gosford area (33°26'S 151°20'E), 25 July 1999, Lyn Abra.

**Diagnosis.** In male: medium sized dark brown spiders, carapace length c. 6.0–7.4; retrodorsal surface of metatarsi IV without spines; venter with dense cover small dark brown maculations (Fig. 4H). Both tarsi I and II with bilateral rows of small spines adjacent to scopula (Fig. 4D–G). Metatarsi I and II with bilateral small clusters of spines near distal edges. Palpal bulb with retrolateral embolic flange with 5 prominent and 2–3 minor folds; embolus tip sinuous from dorsal aspect (Fig. 4B), appears swollen from lateral aspect by thin ventral flange suspended from tip (Fig. 4C); embolic dorsal apophysis absent. Conformation of palp as figured (Fig. 4A). Female not known.

## Description

**Male holotype** (Fig. 4A–H). *Size*. Carapace length 7.18, width 5.59. Abdomen length 8.53, width 5.03. *Colour*. In

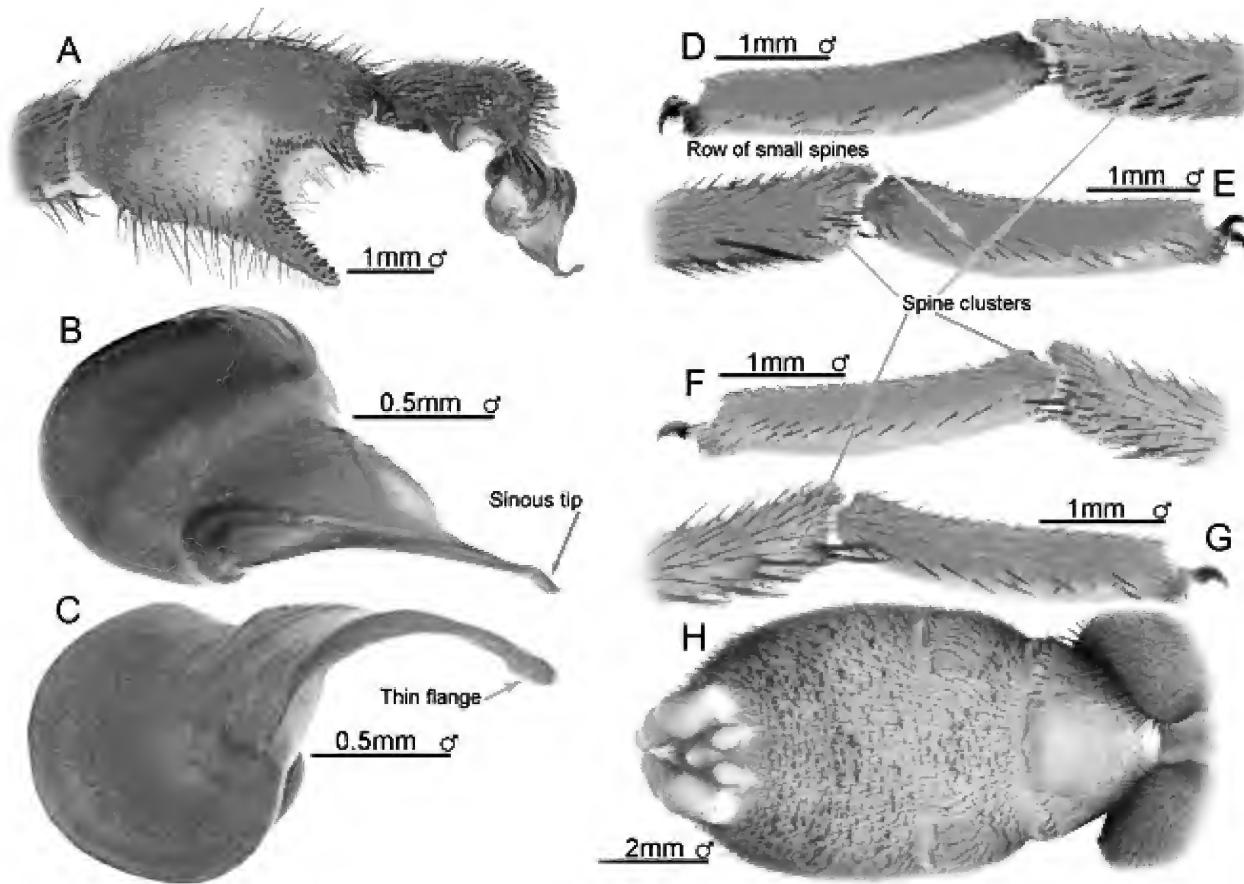


Fig. 4. *Misgolas dougweiri* n.sp. A–H ♂, holotype AM KS50006: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D,E), right tarsus/metatarsus joint I: D, prolateral; E, retrolateral. (F,G), right tarsus/metatarsus joint II: F, prolateral; G, retrolateral. (H), venter.

alcohol carapace, proximal limb segments and chelicerae dark brown. Some pallid hairs on carapace, absent on limbs. Patella and tibia of anterior limbs with weak darker smudges. Abdomen dorsum dark brown with six pale transverse chevrons. Venter pale, covered with many small brown maculations (Fig. 4H). *Carapace*. Edge fringed with black bristles that encroach onto posterior third of post foveal surface. Line of c. 8 (some rubbed off) median bristles on caput arch. Group of 8 bristles on clypeus; group of smaller setae on weakly chitinous area extending onto pleuron membrane below clypeus. Fovea width 1.46, straight with recurved edges, posterior wall centrally divided by large pitted intrusion. *Eyes*. Raised on small mound, area immediately adjacent to eyes black; anterior width 1.15, posterior width 1.10, length 0.73, width/length ratio 1.58. Line joining posterior edges of ALE bisects AME. Posterior row straight in front, recurved behind. *Chelicerae*. Rastellum row of 5(8) spines in front, 4(2) behind. Intercheliceral tumescence elongate each bearing a dark basal spot. Fang groove with 9(9) promarginal teeth & 9(11) smaller retromarginal/intermediate row teeth. *Labium*. Bulbous, length 0.67, width 1.10. Labio-sternal suture broad narrowing centrally. *Maxillae* c. 51(51) short blunt anteroental cuspules. *Sternum*. Length 3.92, width 2.94. Sigilla small, distinct, anterior pair submarginal, mid pair one diameter from margin, posterior pair largest and two diameters from margin. *Legs*. Tibia I with distal bifid apophysis; distal process with 2(2) short pointed spines, proximal process with 1 short and 1 long compact spines and 1 long spine rising from process base.

	palp	I	II	III	IV
femur	3.56	6.26	5.59	4.48	6.32
patella	1.72	3.19	2.94	2.27	3.13
tibia	3.31	4.36	3.87	2.58	5.59
metatarsus	—	4.42	4.05	3.68	5.40
tarsus	1.78	2.82	2.58	2.33	3.19
total	10.37	21.05	19.03	15.34	23.63

*Palp* (Fig. 4A). Cymbium with c. 63 long narrow, stick-like, slightly anteriorly inclined spines distributed over distal half of d surface. RTA digitate, not swollen basally, inclined downwards, covered with squat pointed d spines which continue along rv edge of tibial excavation. DTA long, straight, inclined downwards almost parallel to RTA, suspending c. 13 long v spines. TEM prominent, adjacent to RTA; TET barely visible on anterior side of TEM. *Bulb*. Embolic rl flange with 5 long and 2 minor folds, margin gently convexly curved. Embolus tip sinuous from dorsal aspect (Fig. 4B); appears swollen from lateral aspect by thin v flange suspended from tip (Fig. 4C). Embolic apophysis absent. *Scopula*. Dense and complete on tarsi I, II and on distal eighth of metatarsi I; distal fragment on metatarsi II; absent on legs III and IV. *Trichobothria*. Palp: tarsi 9, tibia pd 5, rd 5. Leg I: tarsi 15, metatarsi 13, tibia pd 4, rd 4. Leg II: tarsi 14, metatarsi 13, tibia pd 7, rd 5. Leg III: tarsi 10, metatarsi 9, tibia pd 6, rd 7. Leg IV: tarsi 11, metatarsi 15, tibia pd 7, rd 6. *Leg spination*. Leg I (Fig. 4D,E): tarsi bilaterial rows small spines adjacent to scopula pv 7, rv 22; metatarsi pv 022 cluster of 7, rv 011 cluster of 21; tibia v

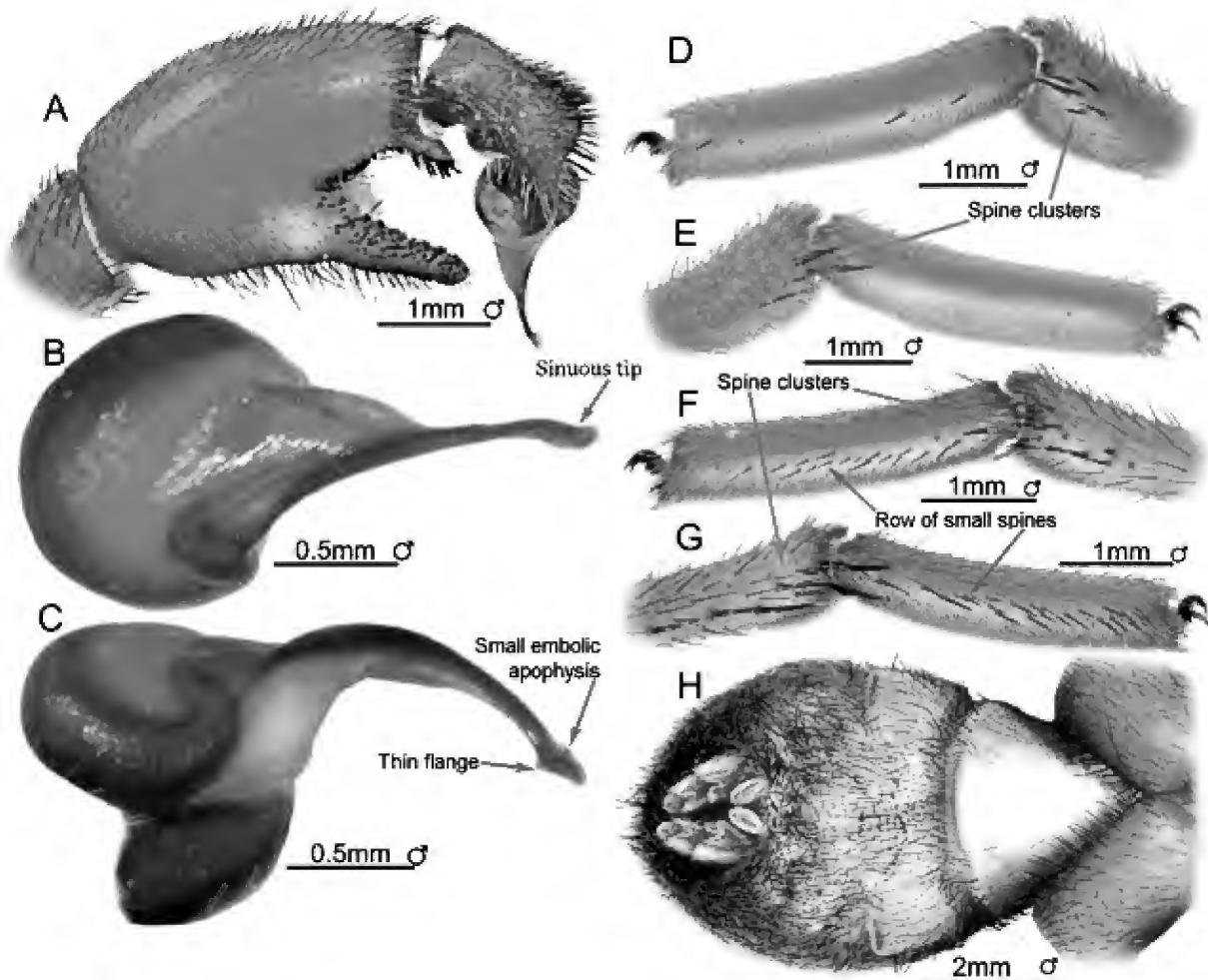


Fig. 5. *Misgolas maxhicksi* n.sp. A–G ♂, holotype AM KS38635: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D, E), right tarsus/metatarsus joint I: D, prolateral; E, retrolateral. (F, G), right tarsus/metatarsus joint II: F, prolateral; G, retrolateral. (H) ♂, paratype AM KS48650, venter.

0012, pl 00010. Leg II (Fig. 4F,G): tarsi bilaterally row small spines adjacent to scopula pv 20, rv 12; metatarsi pv 010 cluster of 9, rv 01111 cluster of 5. Leg III: tarsi v 43, metatarsi v 11, d 002120; tibia v 0112, pl 01010, rl 011; patella pd 8. Leg IV: tarsi v 41; metatarsi v 11; tibia v 022. *Abdomen*. Dorsum with cover of long brown hairs increasing in number, becoming finer laterally and covering venter. Dorsum hairs with underlying fine hairs.

**Remarks.** The species may be confused with other species included in this work that also have the male bulb with a sinuous tip but is separable from them by reference to the absence of an embolic apophysis.

**Etymology.** The species is named in recognition of a good friend of GW, Douglas Weir, late of Gerringong, NSW.

**Distribution and natural history.** (Fig. 24A) This species is known only from the type localities, all near Gosford, N.S.W. The burrow is unknown.

### *Misgolas maxhicksi* n.sp.

Figs 5A–H, 24A

**Type material.** HOLOTYPE M, AM KS38635, Barrington Tops SF, 1.3 km along Bungaree Trail from Barrington Tops Forest Rd (31°56'44"S 151°21'09"E), 1180 m, 4 Feb.–9 Apr. 1993 pitfall trap site 62BR, M. Gray, G. Cassis. PARATYPE ♂: AM KS48650, details same as holotype.

**Other material examined** ♂ ♂, AM KS36720, Chichester State Forest (26/46A), junction of Mt. Allyn Rd. & Allyn River Forest Rd (32°08'S 151°28'E), 355 m, 4 Feb.–9 Apr. 1993, pit fall trap site 36CG, M. Gray, G. Cassis. AM KS36717 (3 specimens), Chichester State Forest (26), Allyn River Forest Rd, 1.1 km north of Mt. Allyn Rd (32°08'S 151°28'E), 378 m, 4 Feb.–9 Apr. 1993, pit fall trap site 38CM, M. Gray, G. Cassis; AM KS86220, details same as KS36717; AM KS86221, details same as KS36717; AM KS38608, Chichester State Forest (16A), Bungari Rd, 1 km from Mt Allyn Rd (32°08'S 151°26'E), 940 m, 4 Feb.–9 Apr. 1993, pit fall trap site 36BM, M. Gray, G. Cassis; AM KS86212, details same as KS38608.

**Diagnosis.** In male: medium sized dark brown spiders, carapace length c. 6.0–7.94; retrodorsal surface of metatarsi IV without spines; venter with dense pattern of brown maculations as figured (Fig. 5H). Tarsi II with bilateral rows of small spines adjacent to scopula margins (Fig. 5F,G), few if any on tarsi I (Fig. 5D,E). Metatarsi I and II with bilateral small clusters of spines near distal edges (Fig. 5D–G). Palpal bulb with retrolateral embolic flange with c. 8 fine folds; embolus tip sinuous from dorsal aspect (Fig. 5B), appears swollen from lateral aspect by thin ventral flange suspended from tip (Fig. 5C); embolus with small subdistal dorsal apophysis (Fig. 5C). Conformation of palp as figured (Fig. 5A). Female not known.

### Description

**Male holotype** (Fig. 5A–H). *Size.* Carapace length 7.94, width 6.27. Abdomen length 7.06, width 4.41. *Colour.* In alcohol, carapace, legs, palps, chelicerae dark brown. Anterior limbs with some indistinct darker smudges most prominent on patella rl surface. Golden hairs on carapace, absent on proximal limb segments. Abdomen dorsum dark brownish black with five pale narrow transverse chevrons. Venter appearing dark, densely covered with small dark maculations (Fig. 5H). *Carapace.* Edge fringed with black bristles that encroach onto posterior third of post foveal surface. Line of 7 median bristles anteriorly inclined on caput arch. Group of 9 bristles between PME; 8 bristles on clypeus. Weakly chitinous area extending onto pleuron below clypeus absent (Wishart, 2006). Fovea width 1.47, straight, posterior wall centrally divided by small pitted intrusion. *Eyes.* Raised on mound. Area immediately adjacent to eyes black; anterior width 1.26, posterior width 1.18, length 0.67, width/length ratio 1.88. Line joining posterior edge of ALE transects anterior third of AME. Posterior row procurved in front, recurved behind. *Chelicerae.* Rastellum row of 6(8) strong spines; c. 6(5) smaller spines retreating along pd chelicerae edges. Intercheliceral tumescence small indistinct. Fang groove with 13(15) promarginal teeth and 16(16) smaller retromarginal/intermediate row teeth. *Labium.* Bulbous, length 0.82, width 1.28. Labio-sternal suture broad, undivided. *Maxillae* c. 52(45) squat blunt anteroventral cuspules. *Sternum.* Length 4.21, width 3.33. Sigilla all round; posterior pair largest; their own diameter from margin. *Legs.* Tibia I with distal bifid apophysis; distal process with 2(2), proximal process with 3(4), short pointed spines.

	palp	I	II	III	IV
femur	4.12	7.06	6.57	5.10	7.35
patella	2.13	3.72	3.43	2.70	3.52
tibia	4.07	4.61	4.31	2.99	6.08
metatarsus	—	5.49	4.90	4.02	6.17
tarsus	1.90	3.23	2.94	2.69	3.23
total	12.22	24.11	22.15	17.50	26.35

*Palp* (Fig. 5A). Cymbium with c. 70 long, narrow, skewer-like, anteriorly inclined spines distributed over distal two thirds of d surface. RTA digitate, not swollen basally, inclined downwards, covered with squat, pointed, d spines which continue along rv edge of tibial excavation; DTA long, straight, inclined downwards, almost parallel to RTA, suspending c. 12 longer v spines. TEM pallid, adjacent to RTA; TET indistinct, barely visible, adjacent to pl base of

TEM. *Bulb.* Embolic rl flange with c. 8 fine folds, margin gently convexly curved. Embolus tip sinuous from dorsal aspect (Fig. 5B), appears swollen from lateral aspect by thin flange suspended from tip (Fig. 5C). Embolus with subdistal d apophysis placed above swollen tip. *Scopula.* Dense and complete on tarsi I and II; dense and incomplete on metatarsi I; less dense and incomplete on metatarsi II; absent on legs III and IV. *Trichobothria.* Palp: tarsi 9, tibia pd 7, rd 6. Leg I: tarsi 13, metatarsi 15, tibia pd 7, rd 7. Leg II: tarsi 12, metatarsi 12, tibia pd 5, rd 5. Leg III: tarsi 10, metatarsi 9, tibia pd 6, rd 6. Leg IV: tarsi 12, metatarsi 15, tibia pd 7, rd 7. *Leg spination.* Leg I (Fig. 5D,E): tarsi pv 011000110; metatarsi v 010, pl 8 in distal cluster, rl 6 in distal cluster; tibia v 0112. Leg II (Fig. 5F,G): tarsi bilateral rows small spines adjacent to scopula pv 15, rv 24; metatarsi pv 0010cluster of 15, rv 0011cluster of 8; tibia v 01112. Leg III: tarsi v 33 on distal two-thirds; metatarsi v 10, d 01222; tibia pl 01010, rl 010111, v 02; patella pd 7 + 4 on distal edge. Leg IV: tarsi v 33 spread over surface; metatarsus v 11, tibia v 02. *Abdomen.* Distorted, possibly discoloured due to preservation effects. Dorsum with sparse cover of short brown hairs increasing in number and length laterally. Venter with dense cover of long brown hairs.

**Remarks.** The species may be confused with other species included in this work that also have the male bulb with a sinuous tip but is separable from them by reference to the position of the small d embolic apophysis.

**Etymology.** The species is named in recognition of a good friend of GW, Max Hicks, late of Lennox Head, NSW.

**Distribution and natural history.** (Fig. 24A) This species is known only from the type locality, Barrington Tops State Forest. The burrow is unknown.

### *Misgolas campbelli* n.sp.

Figs 6A–I, 24A

**Type material.** HOLOTYPE ♂, AM KS44302, "Tuglo", 48 km north of Singleton, N.S.W. (32°15'S 151°20'E), Jan. 1977, collector not known. PARATYPE ♂, AM KS36599, other details as for holotype.

**Diagnosis.** In male: medium sized brown spider, carapace length c. 7–7.4, retrodorsal surface of metatarsus IV without spines; venter pale with even distribution of small dark brown maculations as figured (Fig. 6D). Small spines in bilateral rows adjacent to scopula of tarsi I, if present, weak and to a maximum of 6 per row (Fig. 6E,F); tarsi II with bilateral rows small spines adjacent to scopula margins (Fig. 6G,H). Bilateral clusters of spines (2–17 spines per cluster) adjacent to distal edges of metatarsi I and II (Fig. 6E–H). Palpal bulb (Fig. 6B,C) with retrolateral embolic flange with 4 prominent folds and c. 3 minor folds; embolus tip sinuous from dorsal aspect, appears swollen from lateral aspect by small thin ventral flange suspended from tip. Embolic apophysis prodorsal, acute angled, placed near tip above small flange, best observed from dorsal aspect (Fig. 6B). Conformation of palp as figured (Fig. 6A). Female unknown.

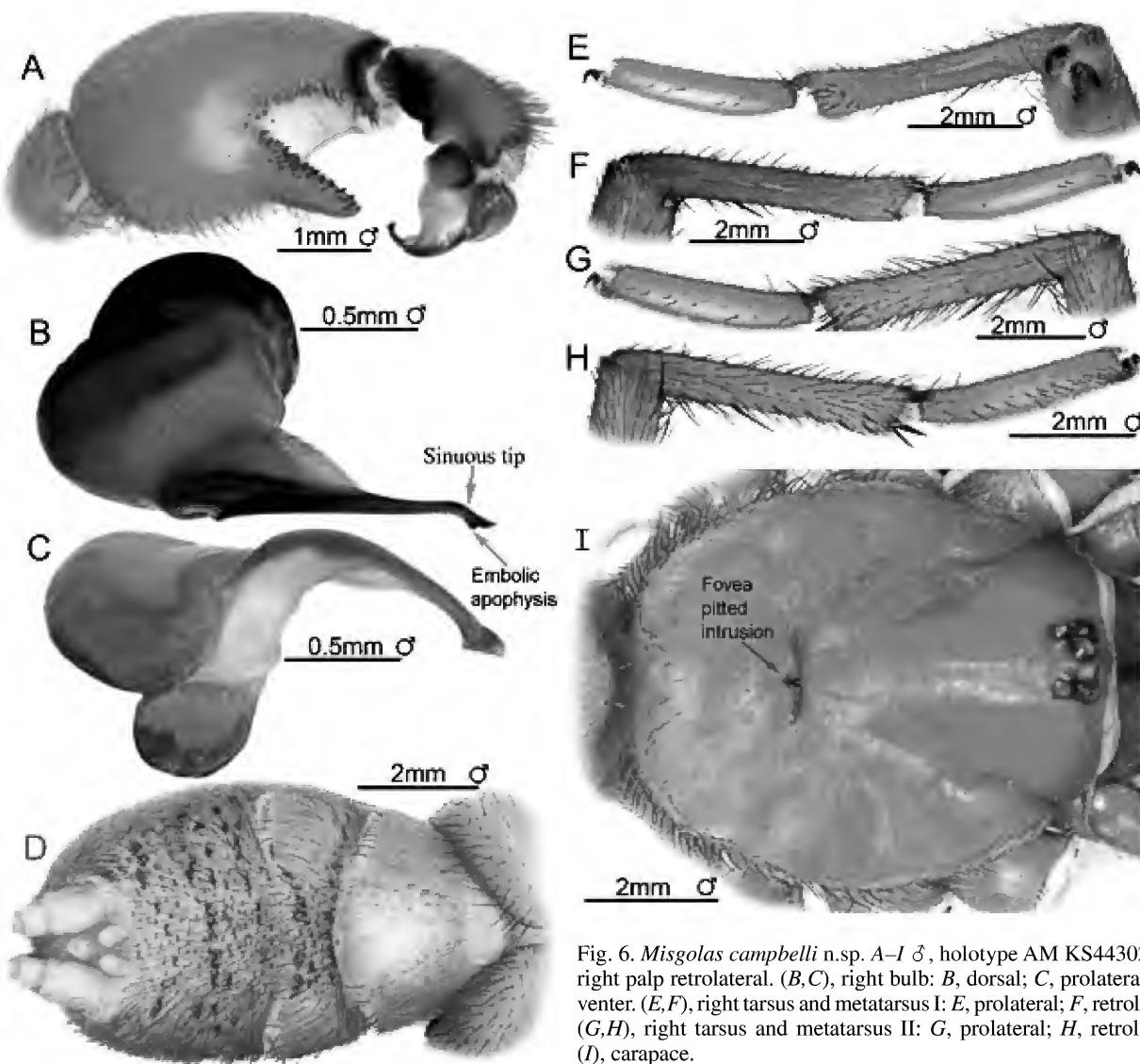


Fig. 6. *Misgolas campbelli* n.sp. A–I ♂, holotype AM KS44302. (A), right palp retro-lateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), venter. (E, F), right tarsus and metatarsus I: E, prolateral; F, retro-lateral. (G, H), right tarsus and metatarsus II: G, prolateral; H, retro-lateral. (I), carapace.

### Description

**Male holotype (Fig. 6A–I).** *Size.* Carapace length 7.35, width 6.37. Abdomen length 7.45, width 4.61. *Colour.* In alcohol chelicerae, carapace and limbs tan, unicolourous. Weak brown bilateral smudges on patella I and II. Abdomen dorsum brown with c. 6 pallid transverse chevrons. Venter pallid with even distribution of small dark brown maculations (Fig. 6D). *Carapace.* Edge fringed with black bristles which encroach onto posterior quarter of post foveal surface. Evidence of lost setae remains on caput arch and interstrial ridges. Fine setae with golden sheen absent. Remains of 3 bristles between PME; 7 bristles on clypeus. Weakly chitinous area extending onto pleuron membrane below clypeus with 4 pallid weak bristles. Fovea width 1.46, straight; posterior wall centrally divided by large deep pitted intrusion (Fig. 6I). *Eyes.* Placed on mound; area immediately adjacent to eyes black. Anterior width 1.20, posterior width 1.12, length 0.74, width/length ratio 1.62. Line joining posterior edges of ALE bisects AME. Posterior row straight in front, recurved behind. *Chelicerae.* Rastellum first row of 7(7) spines, c. 7(7) smaller spines scattered behind. Intercheliceral tumescence and fang groove detail not visible without damaging

chelicerae. *Labium.* Bulbous, length 0.72, width 1.10. Labio-sternal suture narrow, continuous. *Maxillae* c. 35(37) small, pointed, fusiform, antero-oral cuspules, none surmounted by a fine hair. *Sternum.* Length 3.99, width 3.01. Sigilla round, first and second pair submarginal, third pair larger and 1.5 diameters from margin. *Legs.* Right leg IV missing. Tibia I with distal bifid apophysis; distal process with 2(2) short blunt spines, proximal process with 4(3) short mucronate spines and 1(1) long attenuate basal spine.

	palp	I	II	III	IV
femur	3.99	6.81	6.14	4.61	(6.47)
patella	2.09	3.50	3.13	2.52	(3.19)
tibia	3.63	4.54	4.18	2.76	(5.65)
metatarsus	—	5.52	4.67	3.87	(5.59)
tarsus	1.82	3.19	2.94	2.39	(3.01)
total	11.53	23.56	21.06	16.15	(23.91)

*Palp* (Fig. 6A). Cymbium with long, skewer-like, light brown, weak sub-erect spines distributed on distal half of d surface. RTA not swollen, not digitate; covered with d and rd short blunt spines which continue and become pointed on rv edge of tibial excavation; c. 13 longer pointed spines

suspended from short straight DTA. TEM misshapen pallid, adjacent to RTA. TET indistinct on pl surface of TEM. *Bulb.* (Fig. 6B,C) Embolic rl flange with 4 prominent and 3 minor folds; margin gently convexly curved. Embolus tip sinuous from d aspect, appearing swollen from lateral aspect by thin flange suspended from tip. Embolic apophysis pd, acute angled, placed near tip above swelling, best observed from d aspect. *Scopula.* Complete on tarsi I and II; weak and incomplete on metatarsi I and II; absent on legs III and IV. *Trichobothria.* Palp: tarsi 9, tibia pd 5, rd 6. Leg I: tarsi 12, metatarsi 13, tibia pd 6, rd 6. Leg II: tarsi 11, metatarsi 13, tibia pd 6, rd 6. Leg III: tarsi 11, metatarsi 10, tibia pd 4, rd 5. Leg IV: tarsi 11, metatarsi 12, tibia pd 6, rd 6. *Leg spination.* Leg I (Fig. 6E,F): tarsi bilateral rows weak small spines adjacent to scopula pv 6, rv 4; metatarsi v 010, pl distal cluster of 17, rl distal cluster of 3; tibia v 012. Leg II (Fig. 6G,H): tarsi bilateral rows small spines adjacent to scopula pv 8, rv 22; metatarsi v 0111110, pl distal cluster of 11, rl distal cluster of 5. Leg III: tarsi v c. 38, metatarsi v c. 20, d 02220, tibia v 0113, pd 0110, rd 0011; patella pd 7. Leg IV (left leg): tarsi v c. 32; metatarsi v c. 14; tibia v 0112. *Abdomen.* Dorsum with sparse erect bristles and remains of bristles; underlying fine hairs. Venter covered with long weak brown bristles.

**Remarks.** The species may be confused with other species included in this work that also have the male bulb with a sinuous tip but is separable from them by reference to the position of the small, pd, embolic apophysis.

**Etymology.** The species is named in recognition of a good friend of GW, J. Bruce Campbell, late of Gerringong, NSW.

**Distribution and natural history.** (Fig. 24A) This species is known only from the type locality, c. 48 km North of the town of Singleton, N.S.W. The burrow is unknown.

### *Misgolas yorkmainae* n.sp.

Figs 7A–J, 24A

**Type material.** HOLOTYPE ♂, AM KS38616, Kerewong State Forest, nr Lorne, (31°36'S 152°34'E), 15 July 1979, pit fall trap field No. 1600, D. Milledge. PARATYPES ♂♂: AM KS1553, Kerewong SF, nr Lorne, site 108, Kendall Forest Management Area, subtropical rainforest (31°36'S 152°34'E), 28 May 1978, pit fall trap field No. 1167, D. Milledge. AM KS5419, Kerewong SF, nr Lorne, site 108(2), (31°36'S 152°34'E), 15 July 1979, pit fall trap field No. 1597, D. Milledge. AM KS50020, Lorne SF, nr Lorne, site 86(3), 31°35'S 152°37'E, 15 July 1979, pit fall trap field No. 1593, D. Milledge. AM KS86230, all details as for paratype AM KS5419. All type specimens brittle & easily damaged, possibly first preserved in formalin.

**Selection of other material examined.** ♂♂, AM KS38615, Bulga State Forest, Bobbin Fire Trail, 100 m from Padmans Road (31°37'S 152°10'E), 620 m, 4 Feb.–9 Apr. 1993, pit fall trap site 57BM, M. Gray, G. Cassis. AM KS48653, data as for AM KS38615. AM KS38657, Mt. Boss State Forest, 17 1040, North Plateau Rd. at Plateau Beech Picnic Area. Small gully near picnic area end of Plateau Rd. (31°10'S

152°19'E), 4 Feb.–9 Apr. 1993, pit fall trap site 32BG, M. Gray, G. Cassis. AM KS38661, Mt. Boss State Forest, 17 1120, North Plateau Rd. about 1.5 km by track from Plateau Beech Picnic Area (31°10'S 152°19'E), 4 Feb.–9 Apr. 1993, pit fall trap site 32BM, M. Gray, G. Cassis.

**Diagnosis.** In male: large dark tan spiders, carapace length c. 8.3–9.1; retrodorsal surface of metatarsi IV with at least 2 spines (Fig. 7I); venter entirely pallid (Fig. 7J). Bilateral rows of small spines adjacent to scopula on tarsi I and II; bilateral small clusters of spines near distal edges metatarsi I and II (Fig. 7E–H). Palpal bulb (Fig. 7B,C) embolic flange with c. 10 minute folds; embolus with prolateral bend near tip, apophysis absent. Retrolateral tibial apophysis abruptly swollen midway, distal tibial apophysis massive, cymbium spines strong, attenuate, sub erect (Fig. 7A,D). Female not known.

### Description

**Male holotype** (Fig. 7A–J). **Size.** Carapace length 8.82, width 7.35. Abdomen length 7.64, width 5.00. **Colour.** In alcohol limbs and carapace dark tan; dark brown smudges absent from lateral limb surfaces. Abdomen dorsum dark brown with 6 pallid transverse chevrons. Sparse fine pallid hairs most concentrated on carapace near perimeter & extending onto coxae. Venter entirely pallid. **Carapace.** Edge fringed with many long black bristles which extend onto a raised post foveal surface. Line of c. 9 (some rubbed off) median bristles on caput arch. Group of 6 bristles between PME, 7 bristles on clypeus. Area below clypeus on pleuron membrane not chitinous, without setae. Fovea width 1.43, deep, slightly procurved, edges recurved; posterior wall centrally divided by two pitted intrusions. **Eyes.** Raised on mound. Area immediately adjacent to eyes black; anterior width 1.56, posterior width 1.48, length 0.96, width/length ratio 1.63. Line joining posterior edges of ALE transects anterior third of AME. Posterior row recurved in front and behind. **Chelicerae.** Rastellum row of 6(6) strong spines, few smaller spines retreat along pd edges. Intercheliceral tumescence not examined. Fang groove with 9(8) promarginal teeth & 12(12) smaller retromarginal/intermediate row teeth. **Labium.** Bulbous, raised, length 0.87, width 1.05. Labio-sternal suture broad, medially divided. **Maxillae** c. 4–5 (4–5) anteroventral basally thickened setae in lieu of developed cuspules. **Sternum.** Length 4.97, width 3.75. Sigilla, anterior pairs small, round, posterior pair larger, ovate, all their own diameter from margin. **Legs.** Tibia I with distal bifid apophysis; both processes “stump-like” with 2(2) short blunt spines.

	palp	I	II	III	IV
femur	4.78	8.53	8.04	6.88	8.63
patella	2.21	4.41	4.11	3.32	4.11
tibia	4.35	6.276	14.435	7.84	
metatarsus	—	6.96	6.32	5.89	8.13
tarsus	2.03	3.52	3.44	3.44	4.05
total	13.37	29.69	28.05	23.88	32.76

**Palp** (Fig. 7A,D). Cymbium with 37(33) strong, attenuate, sub-erect spines covering anterior half of d surface. RTA abruptly swollen midway, d and rd surfaces covered with short pointed spines; rv edge of tibial excavation and

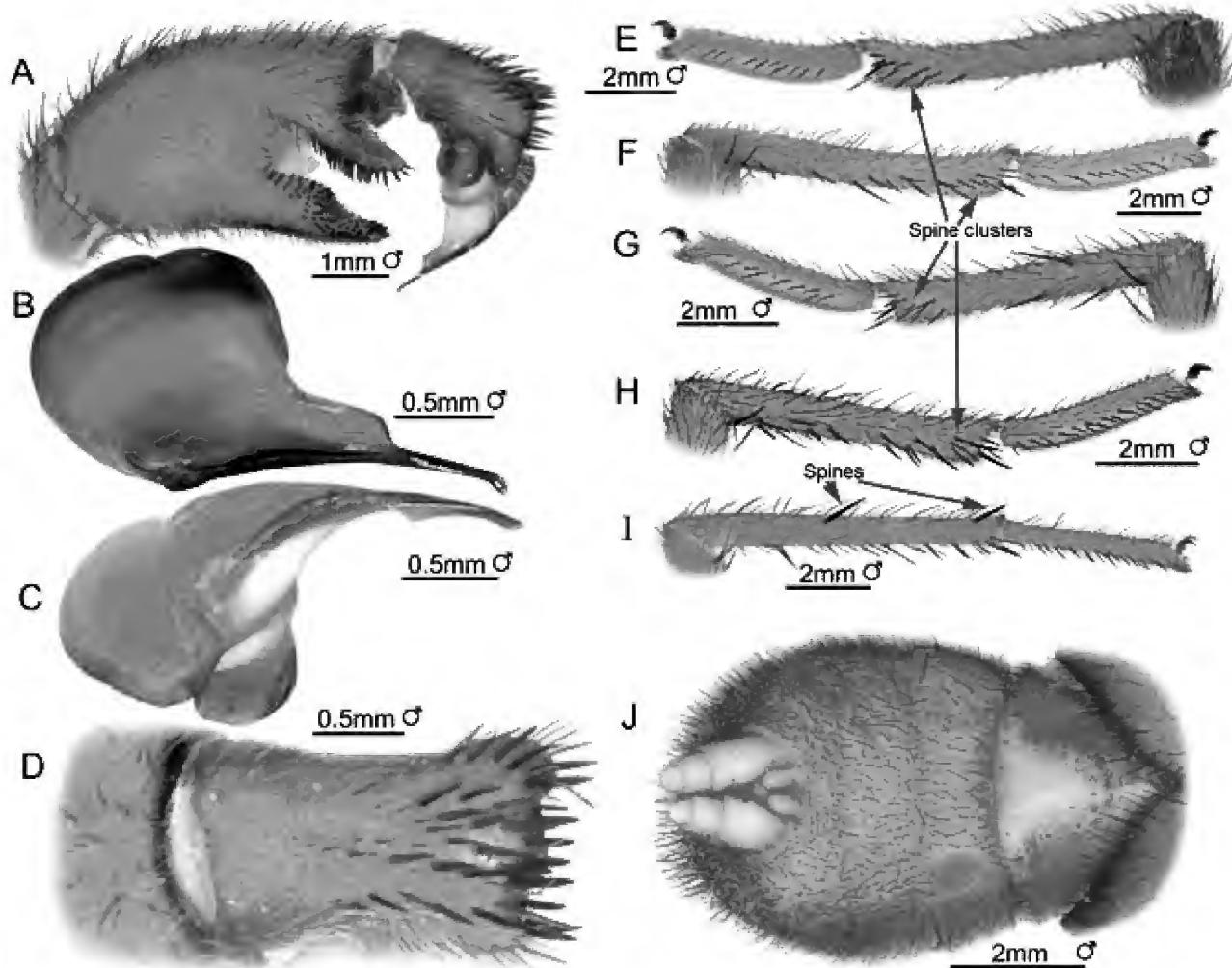


Fig. 7. *Misgolas yorkmainae* n.sp. A–J ♂, holotype AM KS38616. (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), left cymbium dorsal. (E, F), right tarsus and metatarsus I: E, prolateral; F, retrolateral. (G, H), right tarsus and metatarsus II: G, prolateral; H, retrolateral. (I), right tarsus and metatarsus IV retrolateral. (J), venter.

straight massive DTA suspends brush of longer spines. TEM prominent, pallid, adjacent to RTA; TET not seen. *Bulb*. (Fig. 7B,C). Embolic rl flange with c. 10 minute folds, margin distally sharply convex curved under embolus as if twisted; embolus with pl bend near tip, apophysis absent. *Scopula*. Complete on tarsi I and II; small remnants on metatarsi I and II; absent on legs III and IV. *Trichobothria*. Palp: tarsi 11, tibia pd 6, rd 6. Leg I: tarsi 13, metatarsi 12, tibia pd 6, rd 6. Leg II: tarsi 12, metatarsi 11, tibia pd 7, rd 7. Leg III: tarsi 12, metatarsi 12, tibia pd 7, rd 7. Leg IV: tarsi 12, metatarsi 13, tibia pd 9, rd 8. *Leg spination*. Leg I (Fig. 7E,F): tarsi bilateral rows small spines adjacent to scopula pv 12, rv 16; metatarsi apical pv cluster of 12, rv band of 18; tibia pv 011223. Leg II (Fig. 7G,H): tarsi bilateral rows small spines adjacent to scopula pv 16, rv 23; metatarsi pv 0111cluster of 9, rv band of 11 including apical cluster of 8, pd 010; tibia v 0111112. Leg III: tarsi v 62; metatarsi v 21, pd 011110, rd 010110; tibia pl 0110, rl 0110; patella pd 2. Leg IV (Fig. 7I): tarsi v 48; metatarsi v 25, rd 001010; tibia v 8, rl 01110. *Abdomen*. Dorsum covered with long brown bristles and underlying fine pallid hairs. Venter covered by short brown bristles.

**Etymology.** The species is named in recognition of Dr Barbara York Main, doyenne of Australian trapdoor spiders.

**Distribution and natural history.** (Fig. 24A) This species is known only from the type locality, the Kerewong State Forest, near the town of Lorne, N.S.W. The burrow is unknown.

#### *Misgolas helensmithae* n.sp.

Figs 8A–J, 24A

**Type material.** HOLOTYPE ♂, AM KS48654, Bulga State Forest, Homewoods Road, 2.8 km West of Knodingbul Road (31°37'S 152°07'E), 690 m, 4 Feb.–9 Apr. 1993, pit fall trap, site 57CR, M. Gray, G. Cassis. PARATYPES ♂♂: AM KS38642, AM KS92875, AM KS92876, for all paratypes data as for holotype.

**Diagnosis.** In male: medium-large sized dark tan spider, carapace length c. 7.3–8.4; retrodorsal surface of metatarsi IV with spines (Fig. 8I); venter entirely pallid (Fig. 8J). Tarsi I and II with bilateral rows of small spines adjacent to scopula; metatarsi I and II with bilateral distal clusters of

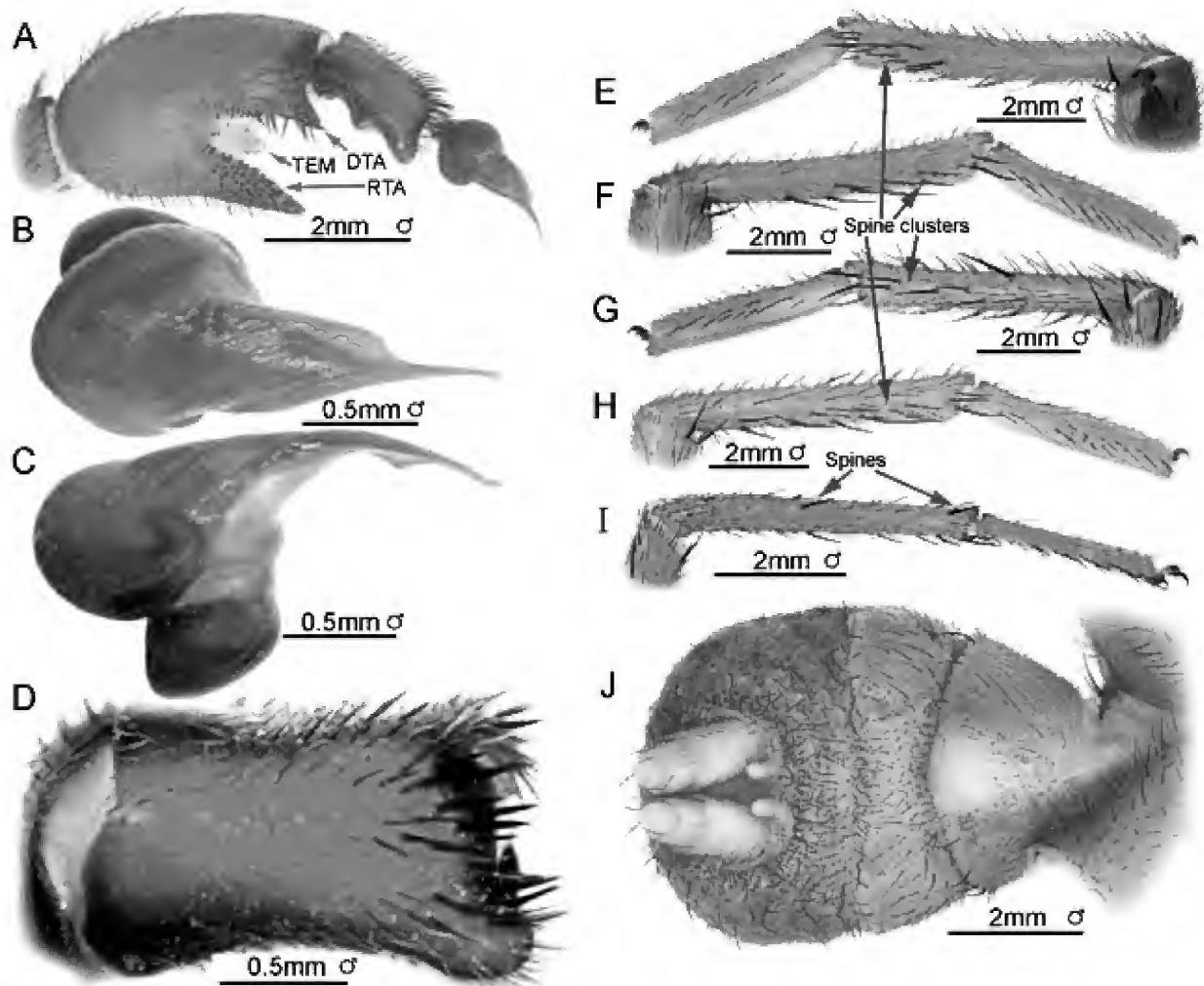


Fig. 8. *Misgolas helensmithae* n.sp. A–H, J ♂, holotype AM KS48654: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), right cymbium dorsal. (E, F), right tarsus/metatarsus I: E, prolateral; F, retrolateral. (G, H), right tarsus/metatarsus II: G, prolateral; H, retrolateral. (J), venter. (I) ♂, paratype AM KS38642: right tarsus/metatarsus IV retrolateral.

spines (Fig. 8E–H). Palpal bulb (Fig. 8B, C) with retrolateral embolic flange with c. 20 minute folds; embolus straight from dorsal aspect, apophysis absent. Retrolateral tibial apophysis digitate; palpal tibia as figured (Fig. 8A). Female not known.

### Description

**Male holotype** (Fig. 8A–J). *Size*. Carapace length 8.42, width 6.66. Abdomen length 6.63, width 4.42. *Colour*. In alcohol carapace, chelicerae and limbs dark tan, v surfaces much paler. Dark brown smudges absent on limbs. Sparse cover of prostrate pallid hairs on carapace, absent on limbs. Abdomen dorsum mottled dark brown bearing c. 5 pallid transverse chevrons. Venter entirely pallid. (Fig. 8J). *Carapace*. Edge fringed with black bristles which encroach onto posterior fifth of post foveal surface. Few small black bristles scattered on caput; line of 6 median bristles on caput arch; 2 bristles between PME, 5 bristles on clypeus; 3 small bristles on weakly chitinous pleuron below clypeus. Fovea width 1.51, gently recurved; posterior wall not pitted. *Eyes*. Raised on mound. Area immediately adjacent to eyes black excepting between ALE and between PME. Anterior width 1.23, posterior width 1.15, length 0.79, width/length ratio

1.56. Line joining posterior edges of ALE bisects AME. Posterior row straight in front, recurved behind. *Chelicerae*. Rastellum row of 5(6) spines; few smaller spines receding along anteroental edge of chelicerae. Intercheliceral tumescence distinct, white, not raised, bearing sparse cover of minute brown prostrate setae. Fang groove with 9(18) promarginal teeth and 15(13) smaller retromarginal/intermediate row teeth. *Labium*. Bulbous, length 0.74, width 1.41. Labio-sternal suture broad, narrowing centrally, divided. *Maxillae* c. 17(21) anteroental long weak attenuate cuspules. *Sternum*. Length 4.42, width 3.07. Sigilla all small, round: Anterior pairs submarginal, posterior pair twice diameter from margin. *Legs*. Tibia I with distal bifid apophysis. Distal process with 1(2) short spine. Proximal process with 3(3) longer spines; 1(1) megaspine rises from d surface of base of proximal process.

	Palp	I	II	III	IV
femur	3.99	7.00	6.69	6.14	7.74
patella	1.84	3.25	3.07	2.82	3.68
tibia	3.80	5.34	5.16	3.87	6.94
metatarsus	—	6.08	5.53	5.22	7.18
tarsus	1.66	3.50	3.31	3.13	3.81
total	11.29	25.17	23.76	21.18	29.35

*Palp* (Fig. 8A,D). Cymbium with c. 32, many broken away, long, attenuate, anteriorly inclined spines distributed over distal third of d surface. RTA digitate centrally slightly swollen, d and rd surfaces covered with squat pointed spines; proximal half of rv edge of tibial excavation suspending c. 23 similar spines; distal half with a sparse brush of c. 15 longer spines terminating at end of short DTA. Small pointed TEM (Fig. 8A) with faint TET adjacent to RTA. *Bulb*. (Fig. 8B,C) Embolic rl flange with c. 21 minute folds, margin distally sharply convexly curved under embolus as if twisted. Embolus straight from d aspect, apophysis absent. *Scopula*. Complete on tarsi I and II, sparse distal remnants on metatarsi I and II, absent on legs III and IV. *Trichobothria*. Palp: tarsi 9, tibia pd 5, rd 5. Leg I: tarsi 10, metatarsi 12, tibia pd 5, rd 5. Leg II: tarsi 11, metatarsi 11, tibia pd 6, rd 6. Leg III: tarsi 12, metatarsi 10, tibia pd 6, rd 7. Leg IV: tarsi 11, metatarsi 15, tibia pd 7, rd 7. *Leg spination*. Leg I (Fig. 8E,F): tarsi pv line of 9 adjacent scopula margin, rv line of 17 adjacent scopula margin; metatarsi pv distal cluster of 12, rv cluster of 12 on distal three-quarters; tibia v 0101123, pd 01010; patella pd 1. Leg II (Fig. 8G,H): tarsi pv line of 12 adjacent scopula margin, rv line of 14 adjacent scopula margin; metatarsi pv cluster of 9 on distal two-thirds, rv cluster of 14 on distal four-fifths, pd 010; tibia v 011114, pd 011110; patella pd 1. Leg III: tarsi v 25 scattered; metatarsi v 14 scattered, d 002220; tibia v 7 scattered, pl 0110, rl 0110; patella pd 4. Leg IV (Fig. 8I): tarsi v 24 scattered; metatarsi v 13 scattered, rd 001010; tibia v 7 scattered. *Abdomen*. Median band of c. 12 long bristles on dorsum; sparse cover short brown bristles with underlying prostrate setae. Venter covered with small brown bristles.

**Etymology.** The species is named in recognition of arachnologist Dr Helen Smith of the Australian Museum, Sydney.

**Distribution and natural history.** (Fig. 24A) This species is known only from the type locality, the Bulga State Forest, c. 30 km ENE of the town of Comboyne, NSW. The burrow is unknown.

### *Misgolas weigelorum* n.sp.

Figs 9A–F, 24C

**Type material.** HOLOTYPE ♂, AM KS10406, Gosford (33°26'S 151°20'E), 10 Jan. 1982, Ramon Mascord.

**Diagnosis.** In male: medium sized brown spider, carapace length c. 6.44; retrodorsal surface of metatarsi IV with at least one spine (Fig. 9E); venter with dark brown pattern as figured (Fig. 9F). Palpal bulb (Fig. 9B,C) with retrolateral embolic flange edge gently curved, with 5 prominent folds and 2–3 minor folds; embolus tip with slight prolateral bend; erect dorsal apophysis placed about midway on embolus. Palpal tibia as figured (Fig. 9A); cymbium distal dorsal surface with weak pallid skewer-like bristles, spines absent (Fig. 9D). Female not known.

### Description

**Male holotype** (Fig. 9A–F). **Size.** Carapace length 6.44, width 5.22. Abdomen length 6.08, width 4.17. **Colour.** In alcohol chelicerae, prosoma and limbs mid tan. Weak dark

brown smudges perceptible on lateral surfaces of patella and tibia. Abdomen dorsum dark brown bearing 6 pallid transverse chevrons. Venter pallid with pattern of dark brown blotches most concentrated on posterior third (Fig. 9F). *Carapace*. Edge with fringe of long black bristles which encroach onto and cover posterior third of post foveal surface. Remains of line of c. 12 median setae on caput arch and remains of c. 8 setae between PME; 12 bristles on clypeus together with fine pallid setae; weakly chitinous pleuron membrane below clypeus with 3 bristles and few pallid setae. Fine golden hairs concentrated along side edge of anterior half of carapace. Fovea width 1.17, slightly recurved; posterior wall centrally divided by pitted intrusion. *Eyes*. Raised on mound. Area immediately adjacent to eyes black. Anterior width 1.07, posterior width 1.02, length 0.74, width/length ratio 1.45. Line joining posterior edges of ALE transects anterior quarter of AME. Posterior row straight in front, recurved behind. *Chelicerae*. Rastellum single row of 7(7) spines. Intercheliceral tumescence detail not visible without damaging chelicerae. Fang groove with 8(8) promarginal teeth and 12(10) smaller retromarginal/intermediate row teeth. *Labium*. Length 0.67, width 1.00. Labio-sternal suture continuous, narrow, broadening laterally. *Maxillae* c. 53(50) anteroventral elongate pointed cuspules, many terminated by a hair. *Sternum*. Length 3.68, width 2.58. Sigilla all round: Anterior pairs small, first pair own diameter from margin, second pair twice diameter from margin, posterior pair larger & three diameters from margin. *Legs*. Tibia I with apical bifid apophysis. Distal process surmounted by 2(2) short pointed spines. Proximal process surmounted by 2(2) long pointed spines, right process basally supporting long erect spine appearing as a megaspine.

	palp	I	II	III	IV
femur	3.67	6.20	5.71	4.61	6.14
patella	1.66	3.07	2.82	2.21	2.82
tibia	3.71	4.85	4.24	2.76	5.34
metatarsus	—	5.28	4.45	3.96	5.65
tarsus	1.62	3.13	2.82	2.52	3.07
total	10.66	22.53	20.04	16.06	23.02

*Palp* (Fig. 9A,D). Many weak, long, pallid, skewer-like bristles point forward from cymbium distal d surface; spines absent. RTA without swelling, d and rd surfaces covered with short pointed spines. Brush of c. 16 longer spines suspended from rv edge of tibial excavation. DTA hooked, with c. 15 short v spines. TEM large, pallid, hemispherical, contiguous with RTA; TET distinct on pl side of TEM. *Bulb*. (Fig. 9B,C) Embolic rl flange gently curved, with 5 major and c. 1–2 minor folds. Embolus straight, tip with slight pl bend. Embolic d apophysis erect, placed c. midway on embolus. *Scopula*. Complete on all tarsi, weak and incomplete on all metatarsi. *Trichobothria*. Palp: tarsi 11, tibia pd 6, rd 5. Leg I: tarsi 12, metatarsi 12, tibia pd 6, rd 5. Leg II: tarsi 12, metatarsi 11, tibia pd 6, rd 5. Leg III: tarsi 10, metatarsi 10, tibia pd 6, rd 6. Leg IV: tarsi 11, metatarsi 12, tibia pd 6, rd 6. *Leg spination*. Spines absent on all tarsi. Leg I: metatarsi v 010; tibia v 01112. Leg II: metatarsi v 011; tibia v 0113. Leg III: metatarsi v 013, pd 001110, rd 0001010; tibia v 0113, pd 0110, rd 0110; patella pd 7. Leg IV (Fig. 9E), metatarsi v 8, rd 010; tibia v 7, pd 00110, rd 010. *Abdomen*. Dorsum with cover of long brown bristles. Venter covered with shorter brown hairs.

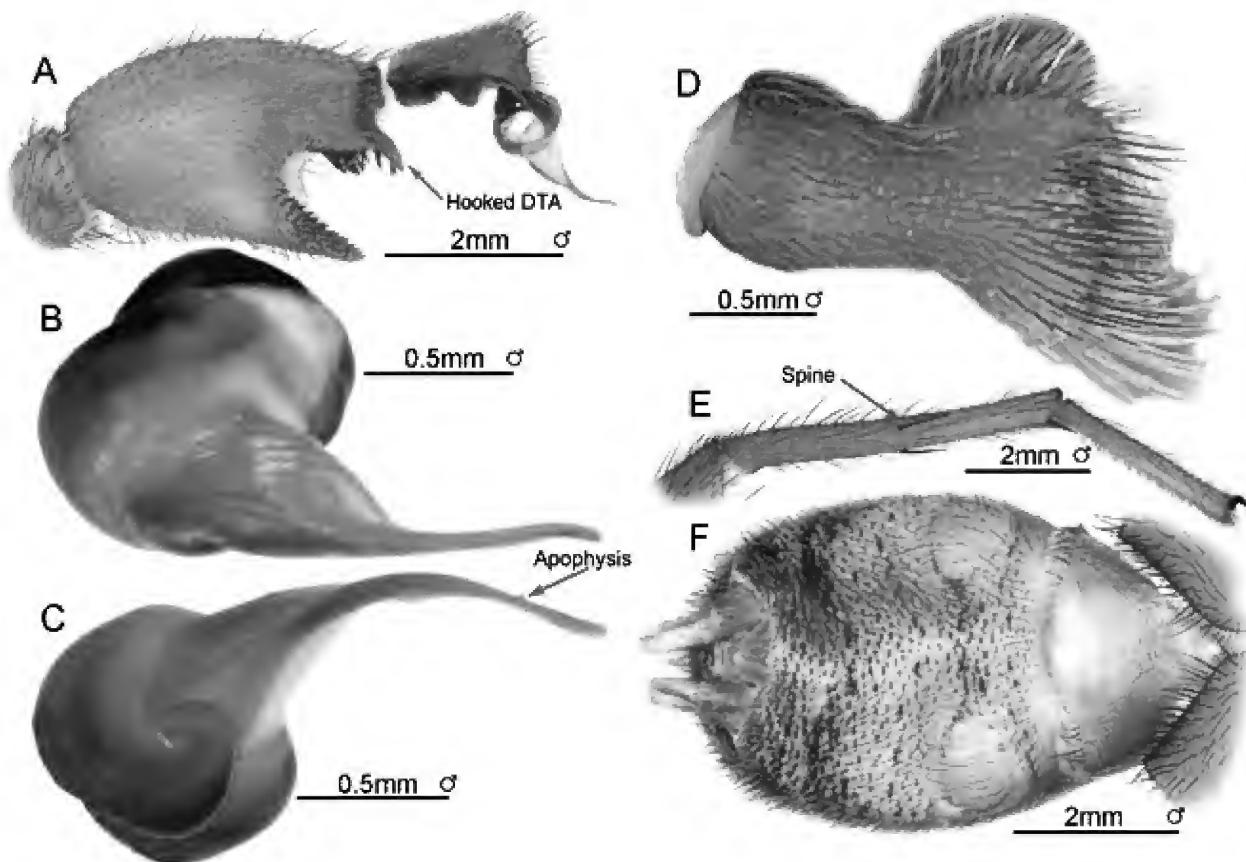


Fig. 9. *Misgolas weigelorum* n.sp. A–F ♂, holotype AM KS10406: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), right cymbium dorsal. (E), right tarsus and metatarsus IV retrolateral. (F), venter.

**Etymology.** The species is named in recognition of Mr and Mrs John Weigel, proprietors of the Australian Reptile Park, Gosford, Australia and the source of countless spider specimens given to the Australian Museum, Sydney.

**Distribution and natural history.** (Fig. 24C) This species is known only from the type locality, the town of Gosford, N.S.W. The burrow is unknown.

#### *Misgolas taiti* n.sp.

Figs 10A–F, 24C

Not *Misgolas hubbardi* Wishart, 1992.—Wishart & Rowell, 1997; removed from inclusion under *M. hubbardi* in the present work.

**Type material.** HOLOTYPE ♂, AM KS5209, Lochinvar (32°42'S 151°27'E), 12 May 1980, Bell (collector). PARATYPE ♂, AM KS3518, Oakhampton (32°42'S 151°34'E), 13 Aug. 1979, Learmonth (collector). Both type specimens brittle as if preserved some time post death.

**Diagnosis.** In male: large dark tan spiders, carapace length c. 8.6–9.3; retrodorsal surface of metatarsi IV without spines or with weak spinules (Fig. 10D); spines absent on all tarsi (Fig. 10E); venter with pattern of brown speckles most concentrated in median longitudinal band (Fig. 10F). Palpal bulb (Fig. 10B,C) retrolateral embolic flange with c. 10 folds; embolic apophysis placed c. one-third of way from embolus

tip towards embolic flange and bent over 90° appearing retrolaterally placed, apex flat, not thornlike. Conformation of palp as figured (Fig. 10A). Female not known.

#### Description

**Male holotype** (Fig. 10A–F). *Size.* Carapace length 8.63, width 7.35. Abdomen length 10.61, width 6.27. *Colour.* In alcohol carapace, legs, palps and chelicerae dark tan. Dark brown smudges absent from lateral limb surfaces. Fine grey hairs on carapace anterior to fovea and proximal limb segments. Abdomen dorsum dark brown with pattern of pallid bands in bilateral series of six. Venter (Fig. 10F) pallid with brown speckles most concentrated in median longitudinal band. *Carapace.* Edge fringed with black bristles that encroach onto posterior third of post foveal surface. Line of c. 6 median bristles on caput arch. Group of 5 broken bristles between PME; 7 posteriorly inclined bristles on clypeus; group of c. 10 smaller setae on weakly chitinous area extending onto pleuron membrane below clypeus. Fovea width 1.70, slightly recurved, edges recurved, posterior wall centrally divided by pitted intrusion. *Eyes.* Raised on mound, area immediately adjacent to eyes black excepting PME; anterior width 1.43, posterior width 1.31, length 0.90, width/length ratio 1.59. Line joining posterior edges of ALE bisects AME. Posterior row procurved in front, recurved behind. *Chelicerae.* Rastellum row of 4(6) spines on anteroventral edge. Several more retreating behind. Fang groove teeth & intercheliceral tumescence detail not visible without damaging chelicerae. *Labium.* Bulbous, length 1.07,

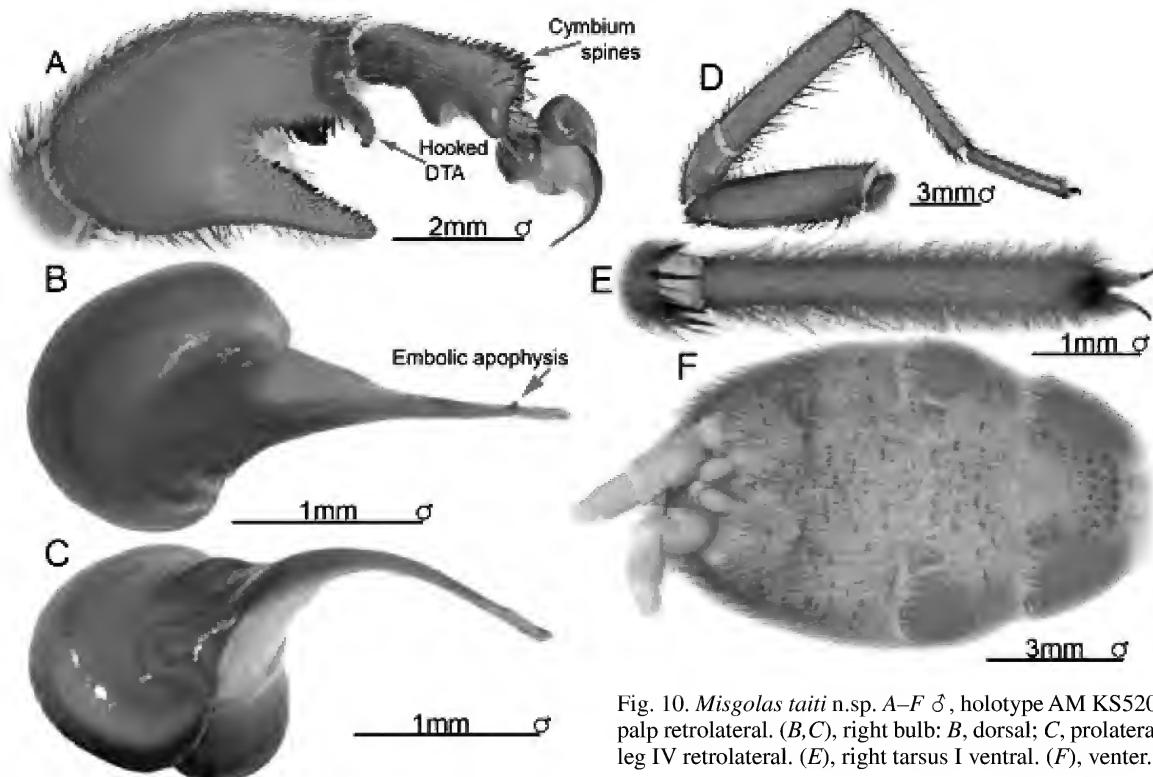


Fig. 10. *Misgolas taiti* n.sp. A–F ♂, holotype AM KS5209: (A) right palp retro-lateral. (B,C) right bulb: B, dorsal; C, prolateral. (D) right leg IV retro-lateral. (E) right tarsus I ventral. (F) venter.

width 1.36. Labio-sternal suture broad, continuous. *Maxillae* c. 70(68) short blunt antero-oral cuspules. *Sternum*. Bulbous. Length 5.58, width 3.82. *Sigilla* all round, equal size; anterior pair close to margin, mid pair their own diameter from margin, posterior pair twice their diameter from margin. *Legs*. Tibia I with distal bifid apophysis; distal process with 2(2) short straight spines, proximal process with 5(4) long compact spines arising from base of apophysis process.

	palp	I	II	III	IV
femur	5.22	9.60	7.74	6.20	8.04
patella	2.39	4.31	3.92	3.13	4.02
tibia	4.97	6.08	5.49	3.87	7.25
metatarsus	—	6.17	5.78	5.40	7.35
tarsus	2.45	3.43	3.33	3.38	3.82
total	15.03	29.59	26.26	21.98	30.48

*Palp* (Fig. 10A). Cymbium with c. 90 short (longer on lateral edges of group), blunt spines anteriorly inclined c. 45° to cymbium axis and distributed over distal third of d surface. RTA d surface swollen midway, covered with squat pointed d spines which continue onto rv edge of tibial excavation; rv edge of excavation with extended brush of c. 26 long spines. DTA hooked, devoid of long spines. TEM prominent, pallid, adjacent to RTA. TET distinct on pl base of TEM. *Bulb*. (Fig. 10B,C) Embolic rl flange with c. 10 fine folds, margin straight. Embolus narrow, apophysis placed c. third of way from embolus tip towards embolic flange, bent over 90° appearing rl placed on embolus; apophysis apex flat, not thornlike. *Scopula*. Dense and complete on all tarsi; dense on distal three-quarters of metatarsi I, distal half of metatarsi II, thin on distal third of metatarsi III, a remnant only on metatarsi IV. *Trichobothria*. Palp: tarsi 9, tibia pd 6, rd 8. Leg I: tarsi 14, metatarsi 13, tibia pd 6, rd 6. Leg II: tarsi 14, metatarsi 13, tibia pd 8, rd 7. Leg III: tarsi 12, metatarsi 14, tibia pd 7, rd 8. Leg IV: tarsi 15, metatarsi 16, tibia pd 8, rd

7. *Leg spination*. (Fig. 10D,E) Spines absent on all tarsi. Leg I: metatarsi v 012, pl 010; tibia v 011112. Leg II: metatarsi v 012, pl 010; tibia v 7 scattered, pd 0110. Leg III: metatarsi v and bilateral c. 22 scattered, d 002220; tibia v 0123, pl 0110; patella pd 11. Leg IV: metatarsi v 11 scattered. *Abdomen*. Separated. Dorsum covered with long brown weak bristles. Shorter prostrate weak bristles cover venter.

**Etymology.** The species is named in recognition of Dr Noel Tait whose work over many years has contributed greatly to our understanding of Australian invertebrate wildlife.

**Distribution and natural history.** (Fig. 24C) This species is known only from the type localities, the neighbouring towns of Lochinvar and Oakhampton, N.S.W. The burrow is unknown.

#### *Misgolas sydjdoranae* n.sp.

Figs 11A–H, 24C

**Type material.** HOLOTYPE ♂, AM KS16132, Kerewong State Forest, nr Lorne, (31°36'S 152°34'E), 7 Nov.–10 Dec. 1978, pit fall trap field No. 1559, D. Milledge. Specimen, possibly first preserved in formalin, brittle & easily damaged.

**Diagnosis.** In male: large dark brown spider, carapace length c. 8.13; retrodorsal surface of metatarsi IV usually without spines (Fig. 11D); venter entirely dark brown (Fig. 11F). All tarsi & metatarsi I & II without spines (Fig. 11G,H). Palpal bulb (Fig. 11B,C) retro-lateral embolic flange with c. 7 fine major folds, c. 3 minor folds; embolus straight with subdistal dorsal apophysis. Distal tibial apophysis long, straight, horizontal (Fig. 11A); cymbium dorsal surface almost entirely covered with numerous short spines as figured (Fig. 11E). Female not known.

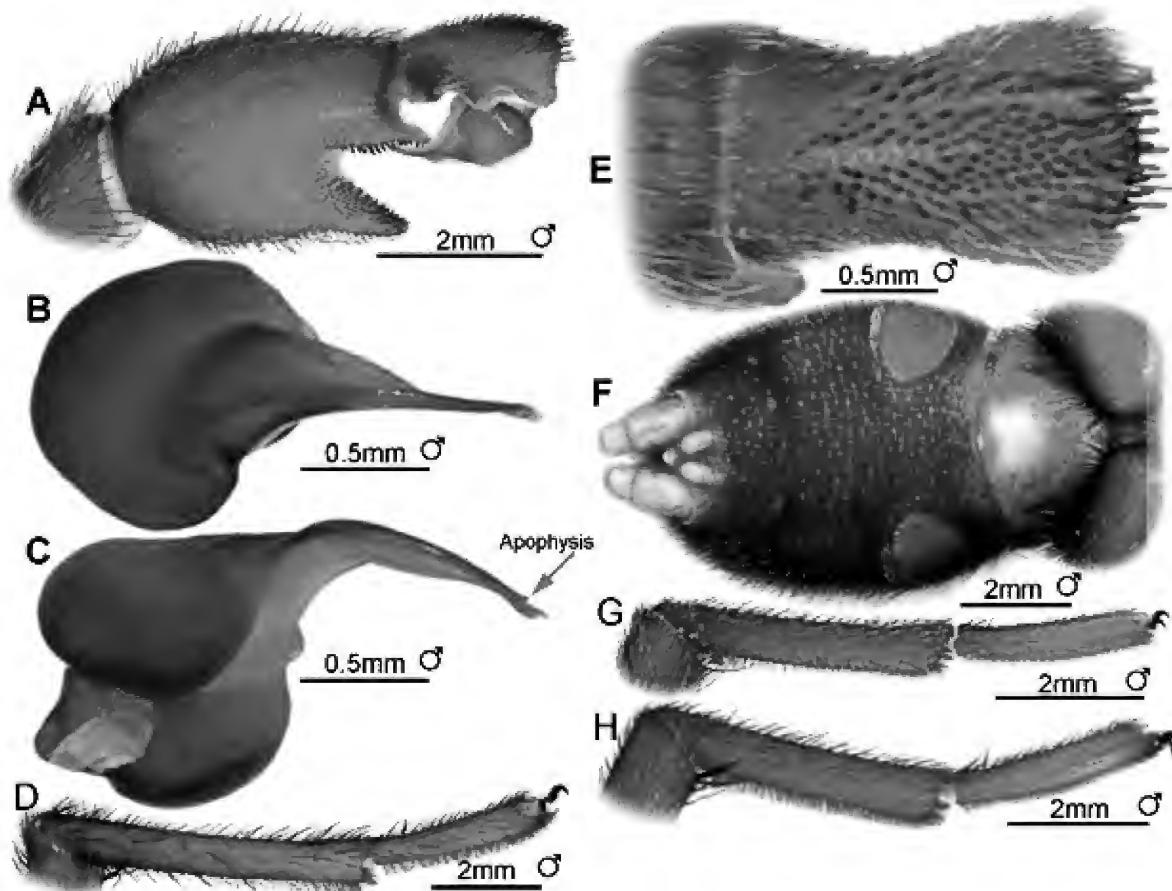


Fig. 11. *Misgolas sydjordanae* n.sp. A–H ♂, holotype AM KS16132: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D), right tarsus and metatarsus IV retrolateral. (E), right cymbium dorsal. (F), venter. (G), right tarsus and metatarsus I retrolateral. (H), right tarsus and metatarsus II retrolateral.

### Description

**Male holotype** (Fig. 11A–H). *Size*. Carapace length 8.13, width 7.16. Abdomen length 9.02, width 5.78. *Colour*. In alcohol chelicerae, carapace, abdomen & all femora dark brown; distal limb segments lighter. Dark brown smudges absent from lateral limb surfaces. Abdomen dorsum with 4 inconspicuous pale transverse chevrons. Fine pallid reflective hairs bedeck carapace & proximal limb segments. Venter entirely dark brown. *Carapace*. Edge fringed with long black bristles which encroach onto posterior third of post foveal surface. Posterior edge truncate. Line of c. 17 median bristles on caput arch (some rubbed off); group of 4 between PME, 15 on clypeus. Weakly chitinous area below clypeus on pleuron membrane with c. 8 setae. Fovea width 1.89, slightly procurved, deep; posterior wall not pitted. *Eyes*. Raised on mound. Area immediately adjacent to eyes black; anterior width 1.54, posterior width 1.28, width/length ratio 1.86. Posterior row recurved in front & behind. *Chelicerae*. Rastellum row of 6(7) spines, c. 5(5) disordered behind. Fang groove, teeth & intercheliceral tumescence detail not visible without damaging chelicerae. *Labium*. Low, length 0.72, width 1.25. Labio-sternal suture deep, narrow, continuous. *Maxillae* c. 64(72) short, blunt, anteroventrally widespread cuspules. *Sternum*. Bulbous, length 4.79, width 3.62. Sigilla all small, round; anterior pair 1 diameter from margin, mid-pair 2 diameters from margin, posterior pair three diameters from margin. *Legs*. Tibia I with distal bifid

apophysis. Distal process with 2 long blunt spines separated by 1 short blunt spine; proximal process with 3(3) long pointed spines.

	palp	I	II	III	IV
femur	4.61	6.86	5.98	5.22	7.25
patella	2.21	3.82	3.43	2.82	3.63
tibia	3.43	4.51	3.92	2.70	6.08
metatarsus	—	4.00	4.31	3.87	5.88
tarsus	1.84	2.84	2.65	2.39	2.84
total	12.09	22.03	20.29	17.00	25.68

*Palp* (Fig. 11A,E). Cymbium with c. 100 short, mucronate spines anteriorly inclined c. 45° to cymbium axis & distributed over distal five-sixths of d surface. RTA d & rd surfaces covered with squat pointed spines; tibial excavation rv edge & long straight horizontal DTA suspends continuous band of numerous longer spines. TEM prominent, adjacent to RTA, pl face weakly chitinous bearing prominent TET. *Bulb*. (Fig. 11B,C) Embolic rl flange with c. 7 fine major folds and c. 3 minor folds; margin straight. Embolus straight with subdistal d thorn shaped apophysis. *Scopula*. Complete on all tarsi. Weaker & complete on metatarsi I, II and III. Weak & incomplete on metatarsi IV. *Trichobothria*. Palp: tarsi 7, tibia pd 6, rd 6. Leg I: tarsi 15, metatarsi 16, tibia pd 7, rd 6. Leg II: tarsi 10, metatarsi 12, tibia pd 6, rd 6. Leg III: tarsi 9, metatarsi 8, pd 5, rd 6. Leg IV: tarsi 11, metatarsi 13, tibia pd 8, rd 6. *Leg spination*. (Fig. 11D,G,H) Spines absent on all tarsi &

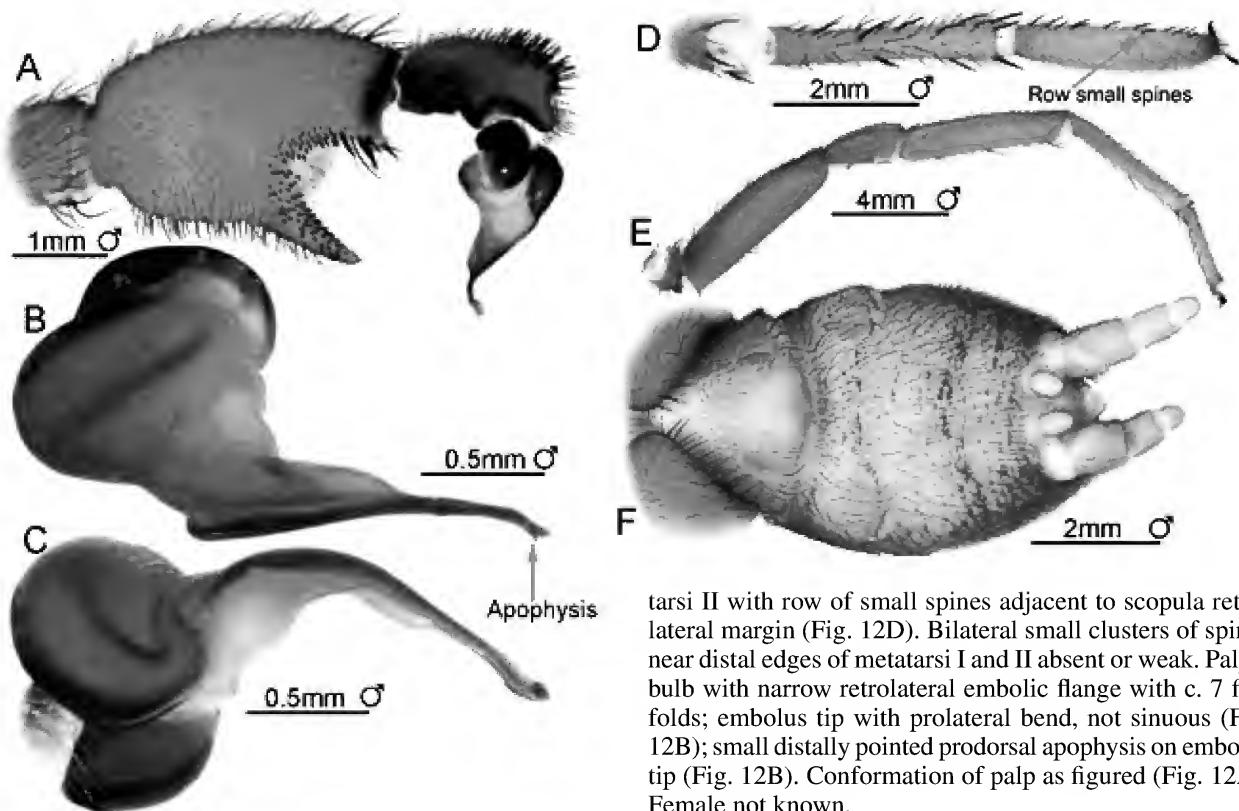


Fig. 12. *Misgolas davidwilsoni* n.sp. A–F ♂, holotype AM KS51761: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D), right tarsus and metatarsus II ventral. (E), right leg IV retrolateral. (F), venter.

metatarsi I & II. Leg I: tibia v 0110. Leg II: tibia v 0111. Leg III: metatarsi pd 011010, rd 001110, pl 001000; tibia v 011, pd 01010, rd 00010; patella pd 8. Leg IV: metatarsi v 0100101, rd evidence of lost spine c. midway (absent on left metatarsi), tibia v 21112. **Abdomen.** Dorsum covered with long brown bristles with underlying prostrate pallid hairs. Venter covered with shorter, weaker bristles.

**Etymology.** The species is named in recognition of Dr Sydney Jordan, innovative trapdoor spider behaviour specialist.

**Distribution and natural history.** (Fig. 24C) This species is known only from the type locality, the Kerewong State Forest near the town of Lorne, N.S.W. The burrow is unknown.

### *Misgolas davidwilsoni* n.sp.

Figs 12A–F, 24C

**Type material.** HOLOTYPE ♂, AM KS51761, Lisarow (33°23'S 151°23'E), 28 Jan. 1998, Lyn Abra. PARATYPE ♂, AM KS51775, Wyoming (33°27'S 151°21'E), 25 Feb. 1999, Lyn Abra.

**Diagnosis.** In male: medium sized tan spider, carapace length c. 7.3–7.8; retrodorsal surface of metatarsi IV without spines (Fig. 12E). Venter pale with pattern of brown speckles in 2–3 weak transverse bands (Fig. 12F). Spines absent on tarsi I;

tarsi II with row of small spines adjacent to scopula retro-lateral margin (Fig. 12D). Bilateral small clusters of spines near distal edges of metatarsi I and II absent or weak. Palpal bulb with narrow retro-lateral embolic flange with c. 7 fine folds; embolus tip with prolateral bend, not sinuous (Fig. 12B); small distally pointed prodorsal apophysis on embolus tip (Fig. 12B). Conformation of palp as figured (Fig. 12A). Female not known.

### Description

**Male holotype** (Figs 12A–F). **Size.** Carapace length 7.31, width 5.77. Abdomen length 7.37, width 4.61. **Colour.** In alcohol carapace, legs, palps and chelicerae mid tan, darker brown smudges absent from lateral limb surfaces. Golden fuscous hairs on caput, absent on limbs. Abdomen dorsum dark brown with distinct pattern of pallid bands in bilateral series of six. Venter pallid with brown speckles most concentrated into three weak transverse bands (Fig. 12F). **Carapace.** Edge fringed with black bristles that encroach onto posterior third of post foveal surface. Line of c. 8 median bristles on caput arch. Group of 10 bristles between PME; 3 posteriorly inclined bristles on clypeus; group of c.10 smaller setae on weakly chitinous area extending onto pleuron membrane below clypeus. Fovea width 1.43, slightly recurved, edges recurved, pitted intrusion absent from posterior wall. **Eyes.** Raised on mound, area immediately adjacent to eyes black, PME excepted; anterior width 1.31, posterior width 1.20, length 0.67, width/length ratio 1.95. Line joining posterior edge of ALE transects anterior third of AME. Posterior row straight. **Chelicerae.** Rastellum row of 6(5) spines on antero-oral edge; few smaller spines retreating along pd edge. Intercheliceral tumescence small, pallid, elongate, raised on a cant. Fang groove with 11(11) promarginal teeth and 14(15) smaller retromarginal/intermediate row teeth. **Labium.** Bulbous, length 0.79, width 1.04. Labio-sternal suture broad, narrowed medially, undivided. **Maxillae** c. 43(51) short blunt antero-oral cuspules. **Sternum.** Length 3.80, width 2.82. Sigilla round, anterior pair small and closest to margin, mid and posterior pairs progressively larger, their own diameter away from margin. **Legs.** Tibia I with distal bifid apophysis; distal process with 2(2) short straight spines, proximal process with 2(2) long bent pointed spines.

	palp	I	II	III	IV
femur	3.44	6.39	5.89	4.85	6.63
patella	1.72	3.19	2.94	2.33	3.07
tibia	3.44	4.61	4.11	2.89	5.71
metatarsus	—	4.42	3.99	3.68	5.46
tarsus	1.72	2.76	2.58	2.34	2.70
total	10.32	21.37	19.51	16.09	23.57

**Palp** (Fig. 12A). Cymbium with c. 54 long, pointed, skewer-like spines, anteriorly inclined c. 45° to cymbium axis, distributed over distal half of d surface. RTA digitate, not swollen basally, inclined slightly downwards, covered with squat pointed d and rd spines which continue along rv edge of tibial excavation terminating with an extended brush of c. 9 long spines. DTA small, reduced to a mound. TEM large, pallid, adjacent to RTA. TET weak, visible on pl region of TEM. **Bulb**. (Fig. 12B,C) Embolic rl flange narrow, with c. 7 fine folds, margin curved under embolus. Embolus curved pl. Tip with pl bend, surmounted by small distally pointed pd apophysis. **Scopula**. Dense and complete on tarsi I and II; dense on distal fifth of metatarsi I and II; absent on legs III and IV. **Trichobothria**. Palp: tarsi 8, tibia pd 5, rd 5. Leg I: tarsi 10, metatarsi 10, tibia pd 6, rd 6. Leg II: tarsi 10, metatarsi 10, tibia pd 6, rd 6. Leg III: tarsi 9, metatarsi 7, tibia pd 6, rd 5. Leg IV: tarsi 10, metatarsi 11, tibia pd 7, rd 6. **Leg spination**. Leg I: metatarsi v 00113; tibia v 0112. Leg II: (Fig. 12D) tarsi rv row of 13 small spines adjacent to scopula; metatarsi v 12 scattered; tibia v 01113. Leg III: tarsi v 42 scattered; metatarsi v 11 scattered, d 002120; tibia v 0113, pd 010, rd 00110; patella pd 8. Leg IV: (Fig. 12E) tarsi v 35 scattered; metatarsi v 0222. **Abdomen**. Dorsum with cover of long brown hairs increasing in number and becoming finer laterally and covering venter. Dorsum hairs with underlying fine hairs.

**Etymology**. The species is named in recognition of Dr David Wilson, venoms researcher.

**Distribution and natural history** (Fig. 24C). This spider is known only from the Lisarow-Berkley Vale locality of the N.S.W. Central Coast. The burrow is unknown.

### *Misgolas crawfordorum* n.sp.

Figs 13A–K, 24C

**Type material.** HOLOTYPE ♂, AM KS86231, 87 Macwood Rd, Smiths Lake (32°23'06"S 152°30'12"E), 24 Nov. 2005, GW. ALLOTYPE ♀, AM KS86232, excavated from front garden, other details same as holotype.

**Diagnosis.** medium (male carapace length, c. 6.45) to large (female carapace length, c. 13.6 maximum) dark brown spiders; retrodorsal surface of metatarsi IV without spines (Fig. 13E,G); venter entirely black (Fig. 13D,H). All femora dark brown, distal limb segments, including patella, much paler (Fig. 13E–G). In male: palpal bulb with retrolateral embolic flange with 4 major, c. 2–3 minor folds; embolus with subdistal prolateral apophysis; small blunt dorsal second apophysis placed midway on embolus remote from tip (Fig. 13B,C). Conformation of palp as figured (Fig. 13A); Retrolateral tibial apophysis digitate.

### Description

**Male holotype** (Fig. 13A–E,I,J). **Size.** Carapace length 6.45, width 5.10. Abdomen length 5.89, width 3.68. **Colour.** In alcohol chelicerae, carapace, abdomen dorsum and all femora dark brown; distal limb segments light tan. Venter entirely black. Faint dark brown lateral smudges present on limbs. Abdomen dorsum bearing 5 pallid transverse chevrons. When dry carapace bedecked with golden hirsute sheen (Fig. 13I); leg segments without golden setae. **Carapace.** Edge fringed with black bristles which encroach onto posterior third of post foveal surface and in files along anterior edges of posterior striae. Line of 11 median bristles on caput arch; 10 bristles between PME; 20 bristles on clypeus; weakly chitinous pleuron membrane below clypeus without setae. Fovea width 1.18, straight, recurved edges; posterior wall not pitted. **Eyes.** Raised on mound. Ocular area black. Anterior width 1.18, posterior width 1.11, length 0.70, width/length ratio 1.69. Line joining posterior edges of ALE transects anterior quarter of AME. Posterior row straight in front, recurved behind. **Chelicerae.** Rastellum single row of 7(7) spines. Intercheliceral tumescence pallid, superior surface with c. 30 long dark setae. Fang groove with 7(7) promarginal teeth and 11(11) smaller retromarginal/intermediate row teeth. **Labium.** Length 0.59, width 0.92. Labio-sternal suture continuous, broadest laterally. Maxillae c. 40(36) squat rounded anteroental cusps, none terminated by a hair. **Sternum.** Length 3.43, width 2.61. Sigilla all round, anterior pair smallest progressing to third pair largest, each c. their own diameter from margin. **Legs.** Tibia I with distal bifid apophysis. Distal process with 2(2) long straight pointed spines; proximal process 2(3) longer curvilinear pointed spines.

	palp	I	II	III	IV
femur	3.76	7.06 (6.63)	6.08	4.42	6.38 (6.14)
patella	1.66	3.13 (3.13)	2.82	2.21	2.82 (2.89)
tibia	3.24	5.53 (5.53)	4.42	2.70	5.59 (5.59)
metatarsus	—	5.34 (5.46)	4.29	3.62	5.28 (5.22)
tarsus	1.50	3.13 (3.32)	2.89	2.39	2.83 (2.58)
total	10.16	24.19 (24.07)	20.50	15.34	22.90 (22.42)

Leg formula: 1 4 2 3.

**Palp** (Fig. 13A). Many long, anteriorly inclined, skewer-like blunt spines on distal half of cymbium d surface. RTA digitate, not swollen, d and rd surfaces covered with long pointed spines becoming shorter around rv edge of tibial excavation and continuing to end of long horizontal DTA. TEM, with posteroventral TET, adjacent to RTA. **Bulb**. (Fig. 13B,C) Embolic rl flange with 4 major folds, c. 2–3 minor folds, margin straight, twisted and extended under short embolus; subdistal pl embolic apophysis terminates long embolic ridge. Small blunt d second apophysis placed midway on embolus remote from tip. **Scopula**. Complete on all tarsi, incomplete on all metatarsi. **Trichobothria**. Palp: tarsi 6, tibia pd 5, rd 5. Leg I: tarsi 12, metatarsi 14, tibia pd 7, rd 7. Leg II: tarsi 12, metatarsi 14, tibia pd 7, rd 7. Leg III: tarsi 11, metatarsi 10, tibia pd 6, rd 7. Leg IV: tarsi 12, metatarsi 14, tibia pd 7, rd 6. **Leg spination**. Spines absent on all tarsi. Leg I: metatarsi v 011000; tibia v 01112. Leg II: metatarsi v 002100; tibia v 011112. Leg III: metatarsi v 010, d 002220; tibia pl 001110, rl 001110; patella pd 8. Leg IV (Fig. 13E): metatarsi v 020, tibia v 4. **Abdomen**. Dorsum with cover of long brown bristles. Venter with cover of shorter weak bristles.

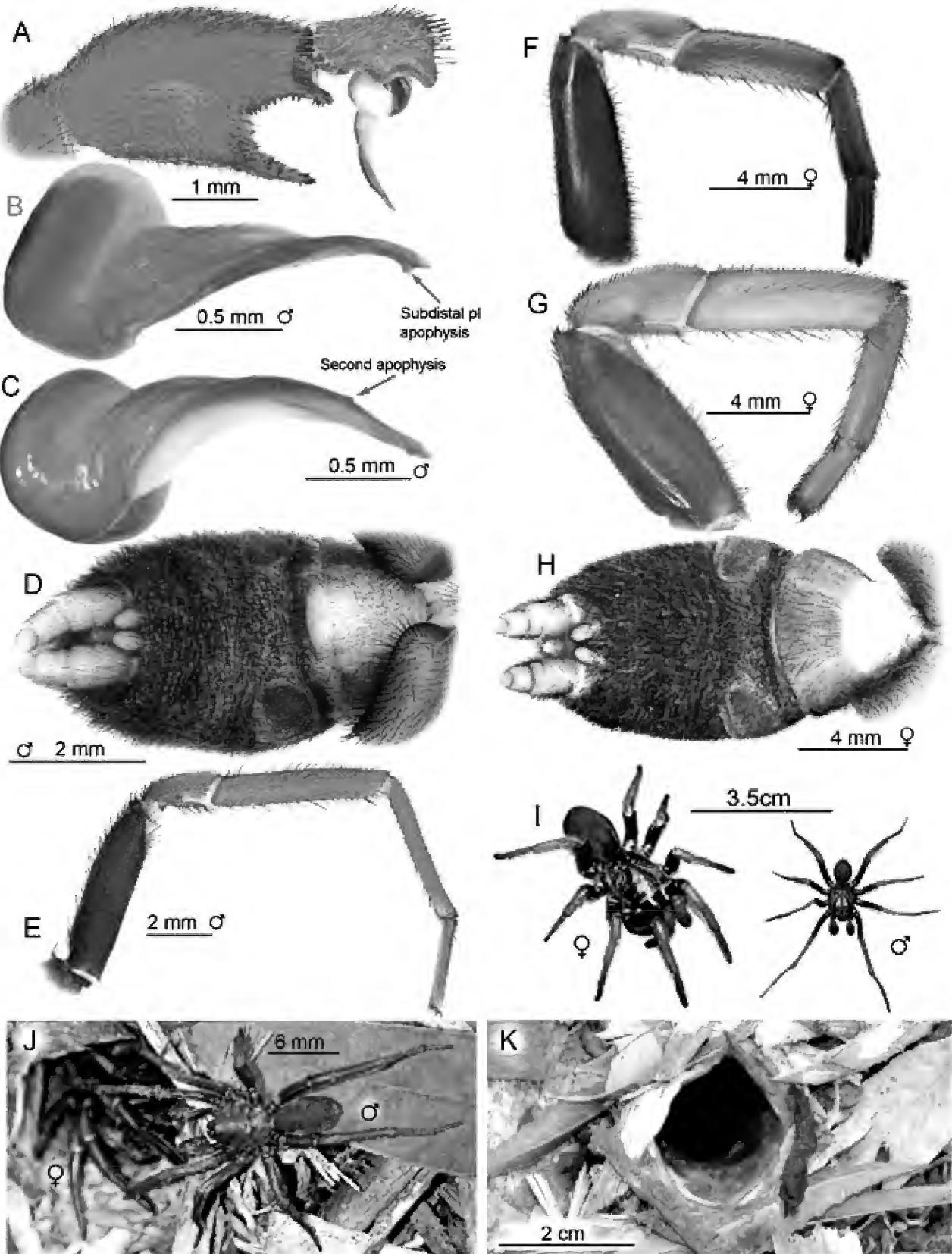


Fig. 13. *Misgolas crawfordorum* n.sp. A–E ♂, holotype AM KS86231: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D), venter. (E), right leg IV retrolateral. F–H ♀, allotype AM KS86232. (F), right leg I retrolateral. (G), right leg IV retrolateral. (H), venter. (I), ♀ and ♂ spiders relative sizes. (J), ♀ and ♂ spiders courting. (K), burrow entrance.

**Female** allotype (Fig. 13F–K). *Size.* Carapace length 13.62, width 9.64. Abdomen length 14.84, width 8.72. *Colour.* In alcohol chelicerae dark brown, carapace and all femora brown, distal limb segments light tan. Abdomen dorsum with 4 pallid transverse chevrons. Venter entirely dense black. Palp and legs I and II with bilateral dark brown smudges (Fig. 13F). When dry carapace bedecked with golden hirsute sheen (Fig. 13I); golden setae extend onto proximal leg segments. *Carapace.* Edge fringed with pale brown hairs which encroach onto posterior third of post foveal surface and in files along anterior edges of posterior striae. Line of 10 (some removed) median bristles on caput arch; 14 bristles between PME; c. 40 bristles on clypeus; weakly chitinous pleuron membrane below clypeus without setae. Fovea width 3.14, straight with recurved edges; posterior wall not pitted. *Eyes.* Placed on low mound. Area immediately adjacent to eyes dark brown. Anterior width 2.00, posterior width 1.95, length 1.10, width/length ratio 1.82. Line joining posterior edges of ALE transects anterior quarter of AME. Posterior row recurved in front and behind. *Chelicerae.* Rastellum row of 9(8) spines; c. 12(12) smaller spines behind. Fang groove with 8(8) promarginal teeth and 31(35) small retromarginal/intermediate row teeth. *Labium.* Bulbous, length 2.05, width 1.61. Labio-sternal suture narrow, continuous. *Maxillae* c. 56(70) short rounded anteroventral cuspules partly masked by copious long orange setae. *Sternum.* Length 7.54, width 6.02. Sigilla distinct, ovate; anterior pair small, mid pair larger, posterior pair largest, each c. three times their own diameter from margin. *Legs:*

	palp	I	II	III	IV
femur	7.74	9.90	8.53	6.45	9.21
patella	4.02	5.59	5.40	4.30	5.39
tibia	4.21	6.17	5.28	3.19	7.25
metatarsus	—	5.10	4.85	4.18	6.27
tarsus	5.09	3.23	2.95	2.58	2.84
total	21.06	29.99	27.01	20.70	30.96

Leg formula: 4 1 2 3.

*Scopula.* Dense, dark grey in colour. Complete v cover on palpal tarsi and tarsi I and II, three-quarters cover on metatarsi I, half cover on metatarsi II, weak remnants on tarsi III and IV. *Trichobothria.* Palp: tarsi 15, tibia pd 8, rd 8. Leg I: tarsi 20, metatarsi 24, tibia pd 13, rd 10. Leg II: tarsi 20, metatarsi 24, tibia pd 10, rd 11. Leg III: tarsi 17, metatarsi 17, tibia pd 10, rd 12. Leg IV: tarsi 18, metatarsi 21, tibia pd 10, rd 10. *Leg spination.* Palp: tarsi pv 2 proximal, rv 01000; tibia pv 0122, v 0111. Leg I: metatarsi v 0110003; tibia v 01111113. Leg II: metatarsi v 6 scattered; tibia v 011111. Leg III: tarsi v 10 in distal group; metatarsi v 9 scattered, pd 011110, rd 0021210; tibia pd 01120, rd 01110; patella pd 12. Leg IV: tarsi v 13 scattered; metatarsi v 11 scattered. *Abdomen.* Dorsum with uniform cover of dark brown bristles extending onto venter, reduced in size over underlying small dark brown bristles. *Genitalia.* Sclerous lip of epigynum straight.

**Taxonomic note:** The unusual leg formula of male holotype is the same taken from both right and left limbs. The holotype is the only male specimen known. The male leg formula is inconsistent with that of the female allotype and all other known *Misgolas* spp. with the exception of males of *M.*

*andrewsi* (Hogg) from South Australia (Main, 1985) and *M. montanus* (Rainbow & Pulleine, 1918) from Jenolan Caves, N.S.W., 1 4 2 3 and 1–4 2 3 respectively.

**Remarks.** The species may be confused with *M. watsonorum* n.sp. For males the species are separable by reference to the digitate RTA and presence of a small d second embolic apophysis.

**Etymology.** The species is named in recognition of Colonel Michael and Mrs Janice Crawford, residents of the type locality.

**Distribution and natural history** (Figs 13J,K 24C) This species is known only from the type locality. Common in gardens, the largest burrows readily identified amongst garden mulch; entrance up to 2 cm diameter; lip attached by silk to leaves and forest debris such that entrance is supported about a centimetre above ground level (Fig. 13K). Below ground level the burrow lined with fragile silken tube to depth of 20 cm. Facet of courting behaviour in the wild is photographed (Fig. 13J).

### *Misgolas watsonorum* n.sp.

Figs 14A–I, 24C

**Type material.** HOLOTYPE ♂, AM KS22419, Cape Hawke nr. Forster, 21 Carmona Drive (32°12'59"S 152°33'02"E), Ken Watson, 10 Jan. 1990, in pool. ALLOTYPE ♀, AM KS92877, excavated from front lawn 29 Jan. 2006, GW, other details same as holotype. PARATYPE ♀, AM KS4517, Cape Hawke nr. Forster (32°11'S 152°31'E), 15 Jan. 1980, Mr Paton.

**Diagnosis.** Medium (male carapace length, c. 6.75) to large (female carapace length, c. 12.85 maximum) brown spiders; retrodorsal surface of metatarsi IV without spines (Fig. 14E,G); venter with moderately dense brown pattern most dense adjacent to PMS (Fig. 14D,H). All femora dark brown (Fig. 14F,G), distal limb segments, including patella, much paler (Figs 14E–G). In male: palpal bulb with retrolateral embolic flange with 4 major folds, c. 2–3 minor folds; embolus with subdistal prolateral apophysis proximally pointed, thorn-like; secondary apophysis absent (Fig. 14B,C). Palpal tibia as figured (Fig. 14A); retrolateral tibial apophysis swollen, not digitate.

### Description

**Male** holotype (Figs 14A–E). *Size.* Carapace length 6.75, width 5.15. Abdomen length 7.74, width 4.54. *Colour.* In alcohol carapace, chelicerae and proximal limb segments up to and including femora dark brown; distal segments and v surfaces of prosoma light tan. Dark brown smudges on some lateral limb surfaces. Abdomen dorsum dark brown bearing 5 pallid transverse chevrons. Venter with moderately dense dark brown pattern most dense immediately adjacent to PMS (Fig. 14D). Spinneret v surface brown, d surface pallid. *Carapace.* Edge with fringe of black bristles encroaching onto posterior third of post foveal surface. Line of 11 (some removed) weak median bristles on caput arch; 8 bristles between PME, 12 on clypeus; weakly chitinous pleuron

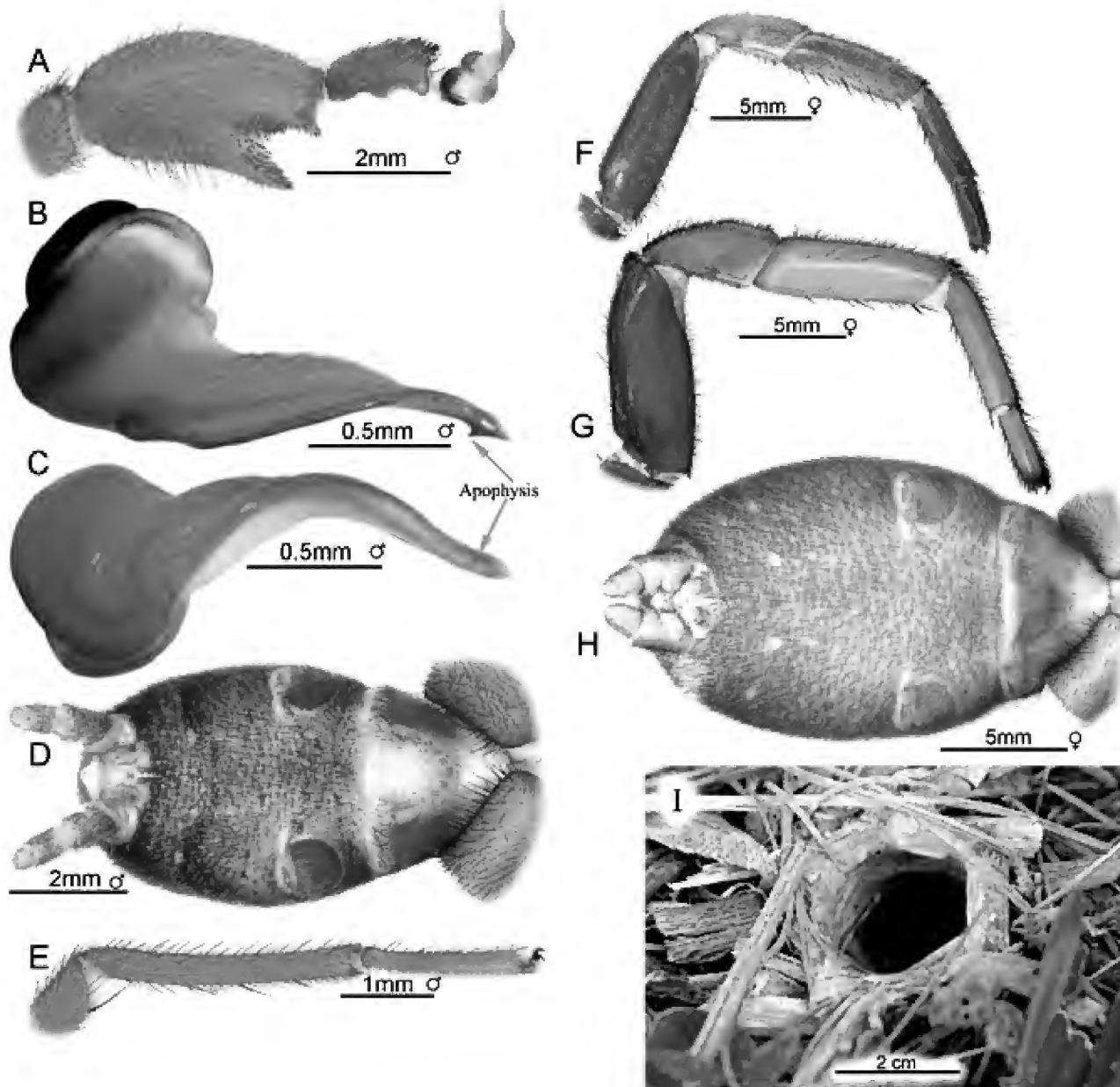


Fig. 14. *Misgolas watsonorum* n.sp. A–E ♂, holotype AM KS22419: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), venter. (E), right tarsus and metatarsus IV retrolateral. F–H ♀, allotype AM KS92877: (F), right leg I retrolateral. (G), right leg IV retrolateral. (H), venter. (I), burrow entrance.

membrane below clypeus without setae. Fovea width 1.10, straight, recurved edges, posterior wall centrally divided by pitted intrusion. *Eyes*. Raised on mound. Area immediately adjacent to eyes black. Anterior width 1.08, posterior width 0.95, length 0.59, width/length ratio 1.85. Line joining posterior edges of ALE bisects AME. Posterior row straight in front, recurved behind. *Chelicerae*. Rastellum row of 5(5) spines; c. 6(8) smaller spines behind. Intercheliceral tumescence small, pallid, indistinct, with few setae. Fang groove with 7(7) promarginal teeth & 8(9) smaller retromarginal/intermediate row teeth. *Labium*. Broad, bulbous, length 0.59, width 0.92. Labio-sternal suture broad, continuous. *Maxillae* c. 35(32) anteroventral pointed, cigar shaped cuspules, none terminated by a hair. *Sternum*. Length 3.50, width 2.58. Sigilla all small, round: Anterior pair marginal, mid pair sub marginal, posterior pair c. 1.5 diameters from margin.

*Legs*. Tibia I with distal bifid apophysis; processes reduced, spines not prominently elevated, distal process with 2(2) attenuate spines; proximal process with 1(2) long curvilinear spine(s) appearing as a megaspine. Tarsi and metatarsi I & II markedly reflexed.

	palp	I	II	III	IV
femur	3.87	6.00	6.07	4.67	6.51
patella	1.72	3.19	2.82	2.27	2.89
tibia	3.50	5.34	4.48	2.89	5.77
metatarsus	-	5.22	4.42	3.87	5.59
tarsus	1.47	3.13	2.82	2.58	3.13
total	10.56	22.88	20.61	16.28	23.89

*Palp* (Fig. 14A). Many long, anteriorly inclined, mucronate, skewer shaped spines on distal half of cymbium d surface. RTA swollen, d and rd surfaces covered with long pointed

spines which continue around rv edge of tibial excavation becoming shorter and continuing to end of DTA. TEM, with posteroventral weak TET, contiguous with RTA. *Bulb.* (Fig. 14B,C) Narrow embolic rl flange with 4 major and c. 2–3 minor folds, margin twisted under short embolus. Embolus with proximally pointed thorn-like subdistal pl apophysis. *Scopula.* Complete on all tarsi, incomplete on all metatarsi. *Trichobothria.* Palp: tarsi 9, tibia pd 5, rd 4. Leg I: tarsi 12, metatarsi 15, tibia pd 7, rd 6. Leg II: tarsi 12, metatarsi 13, tibia pd 7, rd 7. Leg III: tarsi 10, metatarsi 12, tibia pd 7, rd 8. Leg IV: tarsi 11, metatarsi 12, tibia pd 8, rd 7. *Leg spination.* Spines absent on all tarsi. Leg I: metatarsi v 011000; tibia v 01113. Leg II: metatarsi v 012100; tibia v 01112. Leg III: metatarsi v 0102, d 02223; tibia v 0112, pl 010, rl 0110; patella pd 5. Leg IV: metatarsi v 8; tibia v 5. *Abdomen.* Dorsum with dense cover of short brown bristles. Venter with cover of weaker setae.

**Female allotype** (Fig. 14F–H). *Size.* Carapace length 12.85, width 9.33. Abdomen length 18.82, width 11.76. *Colour.* In alcohol chelicerae dark brown, carapace and all femora brown, distal limb segments light tan. Abdomen dorsum with 6 faint pallid transverse chevrons. Venter entirely brown. Palp and legs I and II with bilateral dark brown smudges most apparent on patella and tibia (Fig. 14F). When dry carapace bedecked with golden hirsute sheen, abundant on caput. *Carapace.* Edge fringed with pale brown hairs which encroach onto area between posterior striae. Striae deeply indented. Line of c. 16 (c. 7 removed) small median bristles on caput arch; 16 bristles between PME; c. 35 bristles on clypeus; 3 small dark bristles on weakly chitinous pleuron membrane below clypeus. Fovea width 3.07, straight, posterior wall centrally divided by 2–3 small pitted intrusions. *Eyes.* Placed on low mound. Area immediately adjacent to eyes dark brown, PME excepted. Anterior width 1.74, posterior width 1.69, length 0.88, width/length ratio 1.97. Line joining posterior edges of ALE transects anterior fifth of AME. Posterior row straight in front, recurved behind. *Chelicerae.* Rastellum disordered front row of 10(12) spines; c. 14(11) smaller spines behind. Fang groove with 9(9) promarginal teeth and 32(32) small retromarginal/intermediate row teeth. *Labium.* Bulbous, length 1.66, width 2.17. Labio-sternal suture continuous, narrow centrally. *Maxillae.* An estimated 50(50) short, rounded, anteroventral cuspules masked from view by copious long setae. *Sternum.* Length 6.96, width 5.49. Sigilla anterior pair round, its own width from margin; mid pair larger ovate, one and a half times its length from margin; posterior pair largest ovate, twice its length from margin. *Legs:*

	palp	I	II	III	IV
femur	6.96	9.02	7.84	6.08	8.33
patella	3.82	5.39	5.09	4.11	5.10
tibia	4.12	5.68	4.79	4.70	6.96
metatarsus	—	4.70	4.36	3.81	5.88
tarsus	4.41	2.94	2.58	2.39	2.76
total	19.31	27.73	24.66	21.09	29.03

*Scopula.* Dense, dark grey in colour. Dense v cover on palpal tarsi and tarsi I and II with some thinning along narrow v band. Metatarsi I and II with dense v cover with exception of v band running length of segments broadening proximally. Weak remnants on tarsi III and IV. *Trichobothria.* Palp: tarsi

15, tibia pd 9, rd 9. Leg I: tarsi 18, metatarsi 22, tibia pd 10, rd 10. Leg II: tarsi 19, metatarsi 20, tibia pd 10, rd 9. Leg III: tarsi 17, metatarsi 17, tibia pd 9, rd 10. Leg IV: tarsi 20, metatarsi 20, tibia pd 9, rd 10. *Leg spination.* Palp: tarsi rv 3 proximal, pl 4 proximal; tibia pl 6 scattered, rv 02100. Leg I: metatarsi v 012103; tibia v 011213. Leg II: tarsi v 2 distal; metatarsi v 10 scattered; tibia v 011121. Leg III: tarsi v 10 scattered on distal half; metatarsi v 9 scattered on distal half, pl 0110000, d 0121220; tibia pd 011111, rd 011110; patella pd 12. Leg IV: tarsi v 22 scattered; metatarsi v 9 scattered. *Abdomen.* Dorsum with uniform sparse cover of small dark bristles over underlying fine setae. Venter with dense uniform cover of small dark bristles over underlying fine setae as on dorsum. *Genitalia.* Epigynum lip weakly sclerous, gently recurved.

**Remarks.** The species may be confused with *M. crawfordorum* n.sp. For males the species are separable by reference to the non-digitate RTA and absence of a small d second embolic apophysis.

**Etymology.** The species is named in recognition of Mr Ken Watson, an enthusiastic science teacher, and Mrs Sue Watson, both collectors and residents of the type locality.

**Distribution and natural history.** (Fig. 24C) This species is known only from the type locality and is sympatric with *M. tarnawskiae* n.sp. The burrow entrance favours shaded areas and is commonly found in lawns. The lip is about 10° oblique to the level ground and raised c. 1 cm above the ground resting on grass and leaves (Fig. 14I). The burrow structure is similar to that of *M. crawfordorum*.

### *Misgolas raveni* n.sp.

Figs 15A–G, 24D

**Type material.** HOLOTYPE ♂, AM KS50007, Berkeley Vale (33°20'S 151°26'E), 25 May 1997, Lyn Abra. PARATYPES ♂ ♂: AM KS44405 (right palp missing), Gosford (33°26'S 151°20'E), 13 June 1996, Lyn Abra; AM KS48635 (abdomen damaged), Berkeley Vale (33°20'S 151°26'E), 1 Oct. 1996, Lyn Abra.

**Diagnosis.** In male: medium sized dark brown spiders, carapace length c. 5.8–6.5; retrodorsal surface of metatarsi IV without spines (Fig. 15F). Venter entirely dark brown (Fig. 15G). Spines absent on all tarsi. Bifid apophysis with long linear/curvilinear spines on reduced processes (Fig. 15E). Palpal bulb (Fig. 15B,C) retrolateral embolic flange with 5 long folds; embolus tip with sharp right angle prolateral bend; embolic apophysis absent. Conformation of palp as figured (Fig. 15A). Distal tibial apophysis absent, cymbium with light brown dorsal bristles. Female not known.

### Description

**Male holotype** (Fig. 15A–G). *Size.* Carapace length 6.17, width 4.41. Abdomen length 5.49, width 3.63. *Colour.* In alcohol chelicerae, carapace, d abdomen and all femora dark brown; remaining distal limb segments light tan, some lateral surfaces with pronounced elongate dark smudges (Fig. 15D). Pallid hairs on carapace and proximal limb segments.

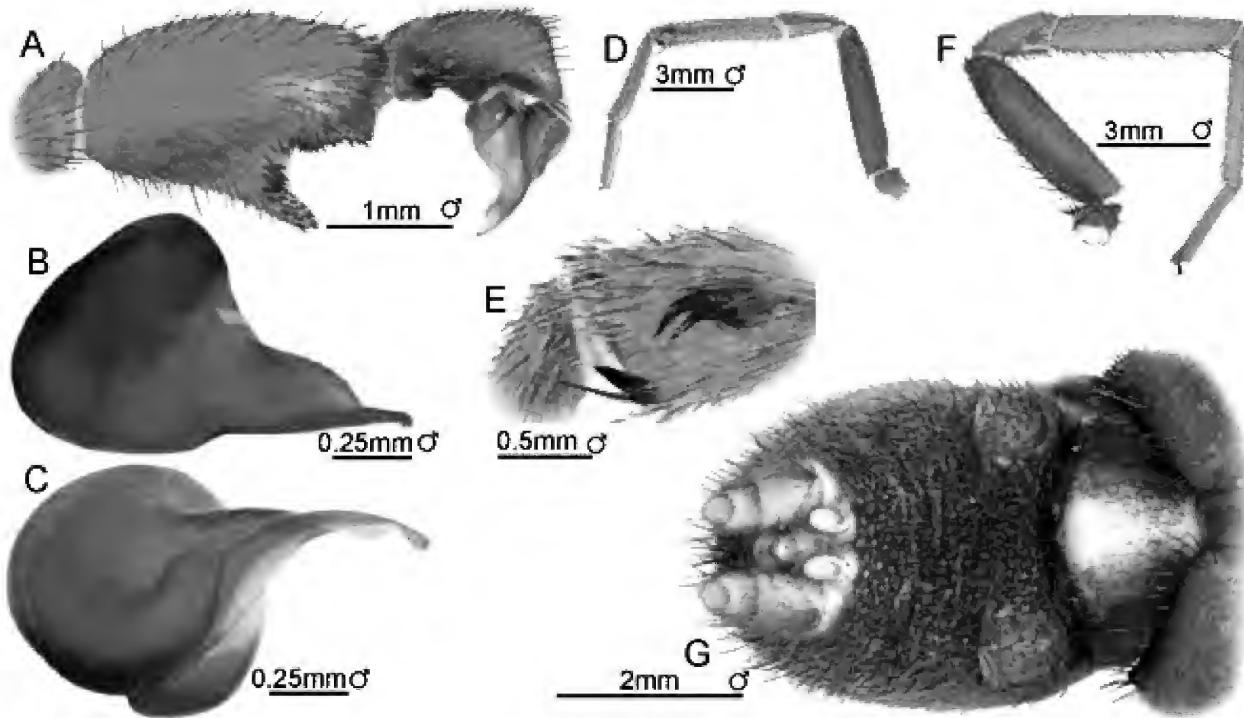


Fig. 15. *Misgolas raveni* n.sp. A–G ♂, holotype AM KS50007: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), right leg I prolateral. (E), right bifid apophysis prolateral. (F), right leg IV retrolateral. (G), venter.

Abdomen dorsum with 5 pale transverse chevrons. Venter entirely dark brown (Fig. 15G). *Carapace*. Edge fringed with black bristles which encroach onto posterior two-thirds of post foveal surface. Line of 5 median bristles anteriorly inclined on caput arch. Group of 8 bristles on clypeus; group of smaller setae on weakly chitinous area extending onto pleuron membrane below clypeus. Fovea width 1.08, slightly recurved, edges recurved, pitted intrusion absent from posterior wall. *Eyes*. Raised on mound, area immediately adjacent to eyes black excepting PME; anterior width 1.02, posterior width 0.92, length 0.56, width/length ratio 1.82. Line joining posterior edges of ALE transects anterior third of AME. Posterior row procurved in front, recurved behind. *Chelicerae*. Rastellum row of 5(5) spines; 1(1) spine behind. Intercheliceral tumescence small. Fang groove with 6(6) promarginal teeth, 7(8) smaller retromarginal/intermediate row teeth. *Labium*. Short, broad, not bulbous. Length 0.33, width 1.00. Labio-sternal suture broad, undivided. *Maxillae* c. 28(19) small assorted blunt and acutely pointed anteroventral cuspules. *Sternum*. Length 3.82, width 2.45. Sigilla all more or less round; posterior pair largest, one diameter from margin; others submarginal. *Legs*. Tibia I with distal bifid apophysis (Fig. 15E); processes reduced, spines not prominently elevated, distal process with 1(1) attenuate symmetrical spine appearing as a megaspine, proximal process with 2(2) long curvilinear spines.

*Palp* (Fig. 15A). Cymbium with c. 56 long, attenuate, light brown bristles, anteriorly inclined, distributed over distal third of d surface; many long fuscous hairs project forward from cymbium lobes. RTA inclined slightly downwards, base swollen, covered with long pointed d and rd spines which continue and are widespread along swollen rv edge of tibial excavation. DTA absent. TEM large, squat, pallid, contiguous with RTA, pl surface with weak TET. *Bulb*. (Fig. 15B,C) Embolic rl flange with 5 long folds, margin strongly convexly curved. Embolus short, apophysis absent, tip with sharp right angle pl bend. *Scopula*. Complete on all tarsi, sparse on tarsi III and IV, sparse on distal fifth of all metatarsi. *Trichobothria*. Palp: tarsi 9, tibia pd 5, rd 5; Leg I: tarsi 13, metatarsi 13, tibia pd 6, rd 6; Leg II: tarsi 11, metatarsi 13, tibia pd 7, rd 7; Leg III: tarsi 11, metatarsi 9, tibia pd 6, rd 6; Leg IV: tarsi 11, metatarsi 13, tibia pd 6, rd 6. *Leg spination*. Absent on all tarsi. Leg I: metatarsi v 010; tibia v 01113. Leg II: metatarsi v 01102; tibia v 0112; Leg III: metatarsi v 012, tibia v 01112, d 022, patella pd 01110. Leg IV: metatarsi v 0111, tibia v 01112. *Abdomen*. Dorsum covered with long dark bristles, decreasing in size laterally, covering venter. Abdomen entirely covered with underlying fine hairs.

**Etymology.** The species is named in recognition of arachnologist, Dr Robert Raven, at the Queensland Museum, Brisbane, Australia.

**Distribution and natural history.** (Fig. 24D) This spider is known only from the Gosford-Berkley Vale locality of the NSW Central Coast. The burrow is unknown.

	palp	I	II	III	IV
femur	2.84	5.76	5.15	3.87	5.66
patella	1.46	2.82	2.58	2.08	2.64
tibia	2.37	4.67	3.99	2.33	5.03
metatarsus	—	3.62	3.38	3.07	4.61
tarsus	1.38	2.27	2.21	2.08	2.33
total	8.05	19.14	17.31	13.43	20.27

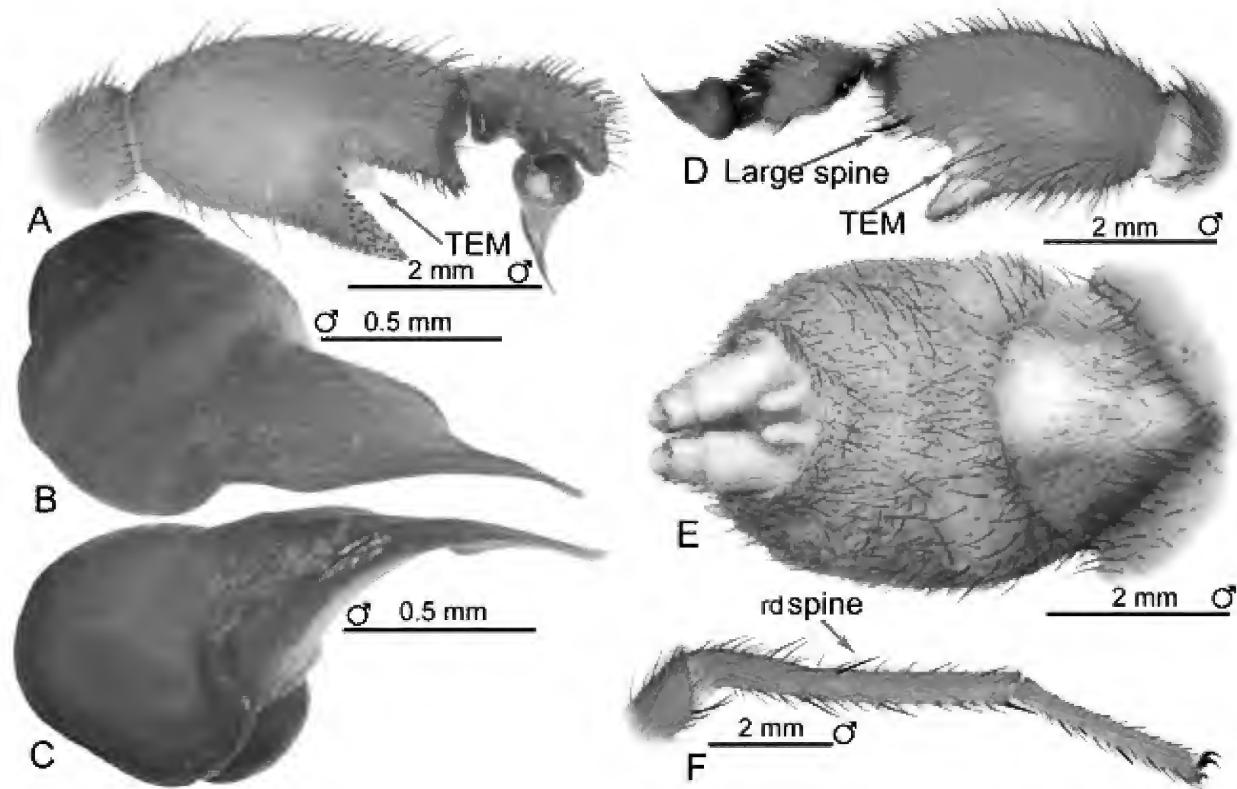


Fig. 16. *Misgolas fredcoylei* n.sp. A–C, E, F ♂, holotype AM KS36704: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. D ♂, paratype AM KS38604: (D), right palp prolateral. (E), venter. (F), right tarsus/metatarsus IV retrolateral.

### *Misgolas fredcoylei* n.sp.

Figs 16A–F, 24D

**Type material.** HOLOTYPE ♂, AM KS36704, Chichester State Forest (RM), Berrico Road, approximately 2 km north of intersection with Kunungra Road (32°05'S 151°45'E), 1,030 m, 4 Feb.–9 Apr. 1993, pit fall trap site 35BR, M. Gray, G. Cassis. PARATYPES ♂ ♂, AM KS38604, Chichester State Forest (RM), Berrico Road, 100 m north of trig. tower (32°06'22"S 151°45'51"E), 940 m, 4 Feb.–9 Apr. 1993, pit fall trap site 35BM, M. Gray, G. Cassis. AM KS86215 & AM KS86219, data as for holotype.

**Other material examined.** Adult ♀ and juvenile, AM KS38605, data as for paratype AM KS38604.

**Diagnosis.** In male: medium sized brown spiders, carapace length c. 6.5–7.5; retrodorsal surface of metatarsi IV with spines, at least one midway (Fig. 16F); venter entirely pallid (Fig. 16E). Palpal bulb (Fig. 16B,C) with retrolateral embolic flange with c. 12 fine folds; embolus short, apophysis absent. Conformation of palp as figured (Fig. 16A,D); cymbium with long blunt stick-like spines inclined c. 45° forward, retrolateral tibial apophysis not basally bent downwards, distal tibial apophysis small; large black subdistal spine projecting from proventral surface of tibial excavation (Fig. 16D). Female not known.

### Description

**Male holotype** (Fig. 16A–F). *Size.* Carapace length 6.51, width 5.34. Abdomen length 5.46, width 3.43. *Colour.* In alcohol carapace, legs, palps & chelicerae light tan; dark brown smudges absent from lateral limb surfaces. Few sparse pallid hairs on caput, absent on limbs. Abdomen dorsum light brown mottled with dark brown; “chevrons” absent. Venter entirely pallid. *Carapace.* Edge fringed with black bristles some extending onto post foveal surface; some smaller bristles on remaining caput area. Line of 6 bristles (some rubbed off) on caput arch. Group of three bristles between PME; group of 9 on clypeus. Area extending onto pleuron membrane below clypeus narrow without setae. Fovea width 0.99, straight, posterior wall not pitted. *Eyes.* Raised on mound. Areas between adjacent eyes black. Widths of anterior and posterior rows c. equal, 1.08 and 1.07 respectively. Eye group length 0.61, width/length ratio 1.75. Line joining posterior edge of ALE transects anterior fifth of AME. Posterior row straight in front, recurved behind. *Chelicerae.* Rastellum first row 6(6) strong spines; c. 11(8) behind and extending along pd cheliceral edge. Intercheliceral tumescence elongate, faint, not distinct. Fang groove with 10(7) promarginal teeth and 9(10) smaller retromarginal/intermediate row teeth. *Labium.* Bulbous, length 0.61, width 1.13. Labio-sternal suture undivided, broad narrowing laterally. *Maxillae* c. 8(13) stick-like anteroventral cuspules. *Sternum.* Length 3.25, width 2.45. Two pairs small round sigilla

separated from margin by their own diameter; posterior third pair absent (present in paratypes). *Legs.* Tibia I with distal bifid apophysis; distal process with 2(2) short blunt spines, proximal process with 3(3) short pointed spines.

	palp	I	II	III	IV
femur	3.50	6.38	6.01	5.09	6.69
patella	1.66	3.01	2.89	2.39	3.00
tibia	3.44	4.67	4.61	3.25	5.65
metatarsus	—	4.55	4.30	4.17	5.77
tarsus	1.60	2.82	2.70	2.64	3.19
total	10.20	21.43	20.51	17.54	24.30

*Palp* (Fig. 16A). Cymbium with c. 38 long, blunt, stick-like spines, each terminated by a posteriorly positioned point, anteriorly inclined c. 45° to cymbium axis and distributed over distal third of d surface and distal two-thirds of pd surface. RTA broad without swellings, d and rd surface covered with c. 45 squat pointed spines; proximal half of rv edge of tibial excavation with c. 30 similar spines; distal half of rv edge with c. 16 longer spines extending onto small straight DTA. TEM prominent, pallid, adjacent to RTA. TET not seen (discernible on paratype AM KS38604). Large black subdistal spine (fractured on right palp) projecting from pv surface of tibial excavation (Fig. 16D). *Bulb.* (Fig. 16B,C) Embolic rl flange with c. 10 fine folds, margin convexly curved, folding under short embolus; embolic apophysis absent. *Scopula.* Dense and complete on tarsi I and II, weak and incomplete on metatarsi I and II, absent on legs III and IV. *Trichobothria.* Palp: tarsi 7, tibia pd 5, rd 6. Leg I: tarsi 10, metatarsi 11, tibia pd 6, rd 5. Leg II: tarsi 10, metatarsi 10, tibia pd 6, rd 7. Leg III: tarsi 10, metatarsi 11, tibia pd 6, rd 6. Leg IV: tarsi 11, metatarsi 13, tibia pd 6, rd 6. *Leg spination.* Leg I: tarsi v 1 subdistal, rv line of 4 adjacent scopula; metatarsi pv 011, rv 0112; tibia v 0112. Leg II: tarsi pv 2 subdistal, rv line of 6 adjacent scopula; metatarsi pv 00111, rv 02132; tibia v 01112, pd 0110. Leg III: tarsi v 10 scattered, rl 01110; metatarsi v 15 scattered, d 002220; tibia v 00112, pl 0110, rl 0110; patella pd 7. Leg IV: (Fig. 16F) tarsi v 16 scattered; metatarsi v 10 scattered, rd 010; tibia v 00113. *Abdomen.* Dorsum with cover of long brown bristles. Hairs and short soft bristles on lateral surfaces. Longer weak bristles on venter.

**Remarks.** The female and juvenile specimens AM KS38605 referred to as "Other material examined" were collected from the same pitfall trap as paratype AM KS38604. Although these specimens are possibly the same species as the holotype they are not recognized as *M. fredcoylei* in this work as spination of metatarsi IV does not conform with that of the male types.

**Etymology.** The species is named in recognition of eminent arachnologist and teacher Frederick A. Coyle, Professor of Biology, Western Carolina University, USA.

**Distribution and natural history** (Fig. 24D). This spider is known only from the Chichester State Forest approximately 25 km South West of the town of Gloucester. The burrow is unknown.

### *Misgolas billsheari* n.sp.

Figs 17A–J, 24D

**Type material.** HOLOTYPE ♂, AM KS86222, Chichester State Forest SF16, Lumeah Road, 1.7 km from Allyn Road (32°06'S 151°45'E), 970 m, 4 Feb.–9 Apr. 1993, pit fall trap site 36BG, M. Gray, G. Cassis. PARATYPES ♂♂, AM KS38602 (4 specimens), data as for holotype; AM KS38609, Chichester SF 16A, Bungari Rd, 1 km from Mt Allyn Rd (32°08'S 151°26'E), 4 Feb.–9 Apr. 1993, pit fall trap site 36BM, M. Gray, G. Cassis; AM KS38625, Chichester SF 16, Mt Allyn Rd. adjacent to Mt Allyn Forest Park, (900 m from junction of Mt Allyn Lookout Rd.) (32°07'S 151°25'E), 970 m, 4 Feb.–9 Apr. 1993, pit fall trap site 36BR, M. Gray, G. Cassis.

**Diagnosis.** In male: medium sized brown spiders, carapace length c. 6.0–6.6; retrodorsal surface of metatarsi IV with spines (Fig. 17J); venter pallid with short dark brown maculations concentrated in median band, most dense between posterior book lungs (Fig. 17D). Palpal bulb (Fig. 17B,C) with retrolateral embolic flange with 6 prominent and c. 3 minor folds, distal edge curved under embolus; embolic apophysis absent. Conformation of palp as figured (Fig. 17A); cymbium with c. 30 long attenuate spine projecting forward, retrolateral tibial apophysis basally bent downwards, distal tibial apophysis large.

### Description

**Male holotype** (Figs 17A–J). *Size.* Carapace length 6.57, width 5.10. Abdomen length 6.08, width 3.23. *Colour.* In alcohol carapace, legs, palps and chelicerae mid-tan; anterior patellae with weak bilateral dark brown smudges. Pallid hairs absent from carapace and limbs. Abdomen dorsum dark brown with six pallid transverse chevrons (Fig. 17E). Venter pallid with short dark brown maculations most concentrated in longitudinal median band, most dense between posterior book lungs (Fig. 18D). *Carapace* (Fig. 17E). Edge fringed with black bristles for the most part in single orderly row, a few encroach onto post foveal surface; smaller bristles are associated with each stria and caput; row of 10 (some rubbed off) on caput arch. Group of 7 bristles between PME, 6 on clypeus. Fovea width 1.20, straight, edges recurved. Posterior wall not pitted. *Eyes.* Raised on mound, area adjacent to eyes black; anterior width 1.13, posterior width 1.10, length 0.67, width/length ratio 1.69. Line joining posterior edge of ALE bisects AME. Posterior row recurved in front and behind. *Chelicerae.* Rastellum row of 6(6) spines; 1(1) behind. Intercheliceral tumescence a small raised basal cant with sparse cover of brown prostrate setae and extending distally as narrow pallid area without setae. Fang groove with 8(8) promarginal teeth & 6(6) smaller retromarginal/intermediate row teeth. *Labium.* Bulbous, length 0.54, width 1.08. Labio-sternal suture broad, continuous. *Maxillae* c. 20(16) short, rounded, anteroventral cuspules. *Sternum.* Length 3.25, width 2.46. Sigilla all round, anterior pair small submarginal; mid pair larger, own diameter from margin; posterior pair largest, 1.5 diameters from margin. *Legs.* Tibia I with distal bifid apophysis, each process with 2 spines.

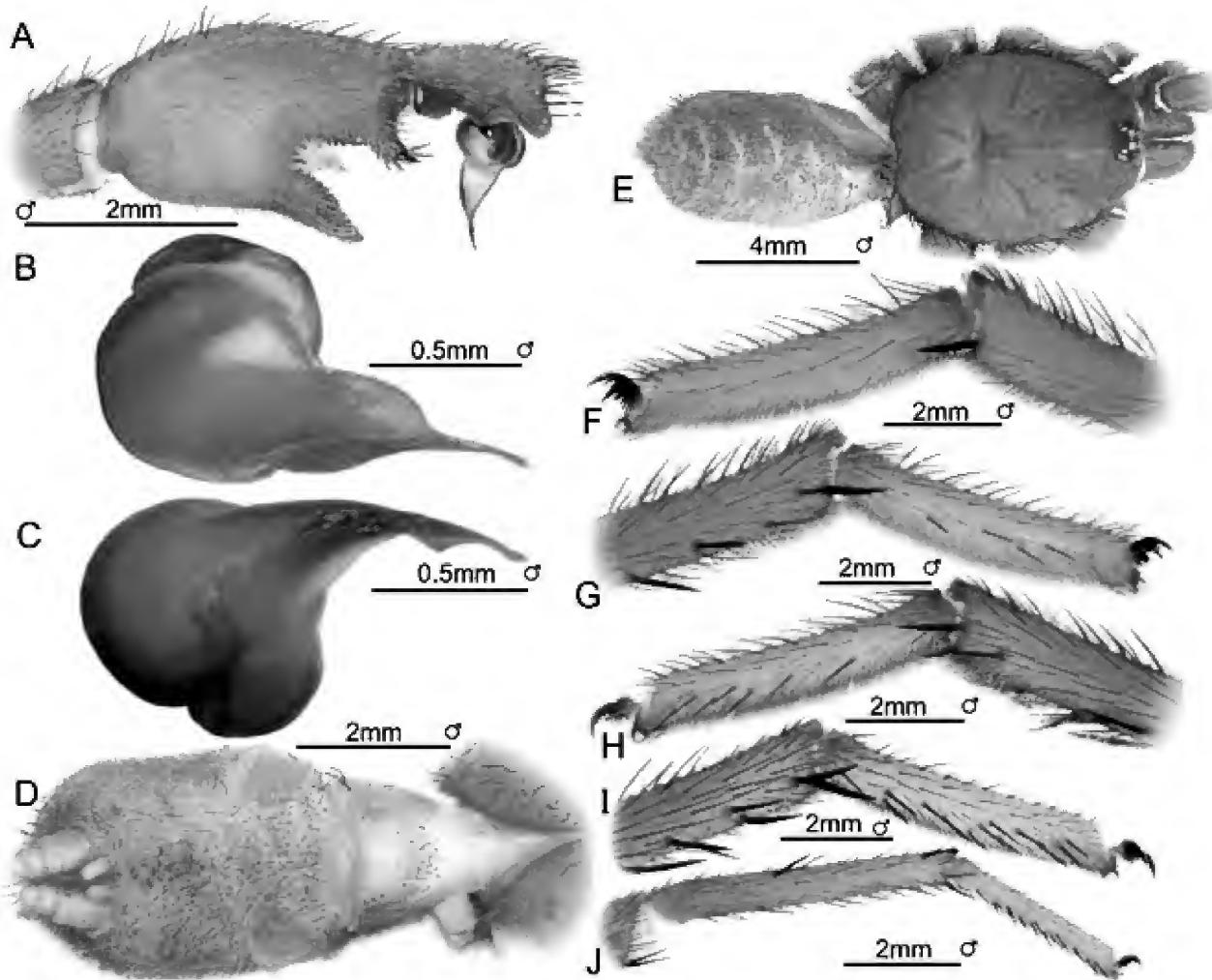


Fig. 17. *Misgolas billsheari* n.sp. A–J ♂, holotype AM KS86222: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D), venter. (E), dorsum. (F,G), right tarsus/metatarsus joint I: F, prolateral; G, retrolateral. (H,I), right tarsus/metatarsus joint II: H, prolateral; I, retrolateral. (J), right tarsus and metatarsus IV retrolateral.

	palp	I	II	III	IV
femur	3.19	5.59	5.22	4.55	5.89
patella	1.72	2.95	2.76	2.27	2.95
tibia	3.01	4.11	3.87	2.88	5.59
metatarsus	—	4.17	3.87	3.68	5.28
tarsus	1.41	2.52	2.39	2.39	2.95
total	9.33	19.34	18.11	15.77	22.66

**Palp** (Fig. 17A). Cymbium with c. 30 long, attenuate spines projecting forward distributed over distal third of d surface; some long pallid hairs project forward from lobes. RTA basally bent downwards c. 30°, base swollen, d and rd surface covered with squat pointed spines which continue around tibial excavation and along rv edge; c. 24 longer attenuate spines suspended from short straight DTA. TEM prominent, conical, pallid, adjacent to RTA. TET discernible on pl surface of TEM. **Bulb**. (Fig. 17B,C) Embolic rl flange with 6 prominent plus 3 minor folds, margin distally convexly curved under embolus as if twisted; embolus straight, apophysis absent. **Scopula**. Complete on tarsi I, weak and complete on tarsi II, weak and incomplete on metatarsi I and II, absent on legs III and IV. **Trichobothria**. Palp: tarsi

8, tibia pd 6, rd 6. Leg I: tarsi 11, metatarsi 12, tibia pd 7, rd 7. Leg II: tarsi 11, metatarsi 11, tibia pd 7, rd 7. Leg III: tarsi 13, metatarsi 10, tibia pd 6, rd 7. Leg IV: tarsi 14, metatarsi 14, tibia pd 8, rd 7. **Leg spination**. Leg I (Fig. 17F,G): tarsi rv line of 5 adjacent scopula; metatarsi pv 01, rv 00011111; tibia v 8, pd 01010. Leg II (Fig. 17H,I): tarsi pv line of 6 & rv line of 13 both adjacent scopula; metatarsi v 12; tibia v 8, pd 01010. Leg III: tarsi v c. 25; metatarsi v c. 13, d 002220; tibia v 0222, pl 0110, rl 0110; patella pd 5. Leg IV (Fig. 17J): tarsi v c. 27; metatarsi v c. 23, rd 0010010; tibia v 0222, rd 001010. **Abdomen**. Hairs absent. Dorsum with long erect brown bristles and understory small posteriorly inclined bristles. Venter with cover of light brown erect bristles.

**Etymology**. The species is named in recognition of William A. Shear, gifted teacher and Charles Patterson Distinguished Professor of Biology, Hampden-Sydney College, Virginia, USA.

**Distribution and natural history** (Fig. 24D). This spider is known only from the Chichester State Forest approximately 25 km South West of the town of Gloucester. The burrow is unknown.

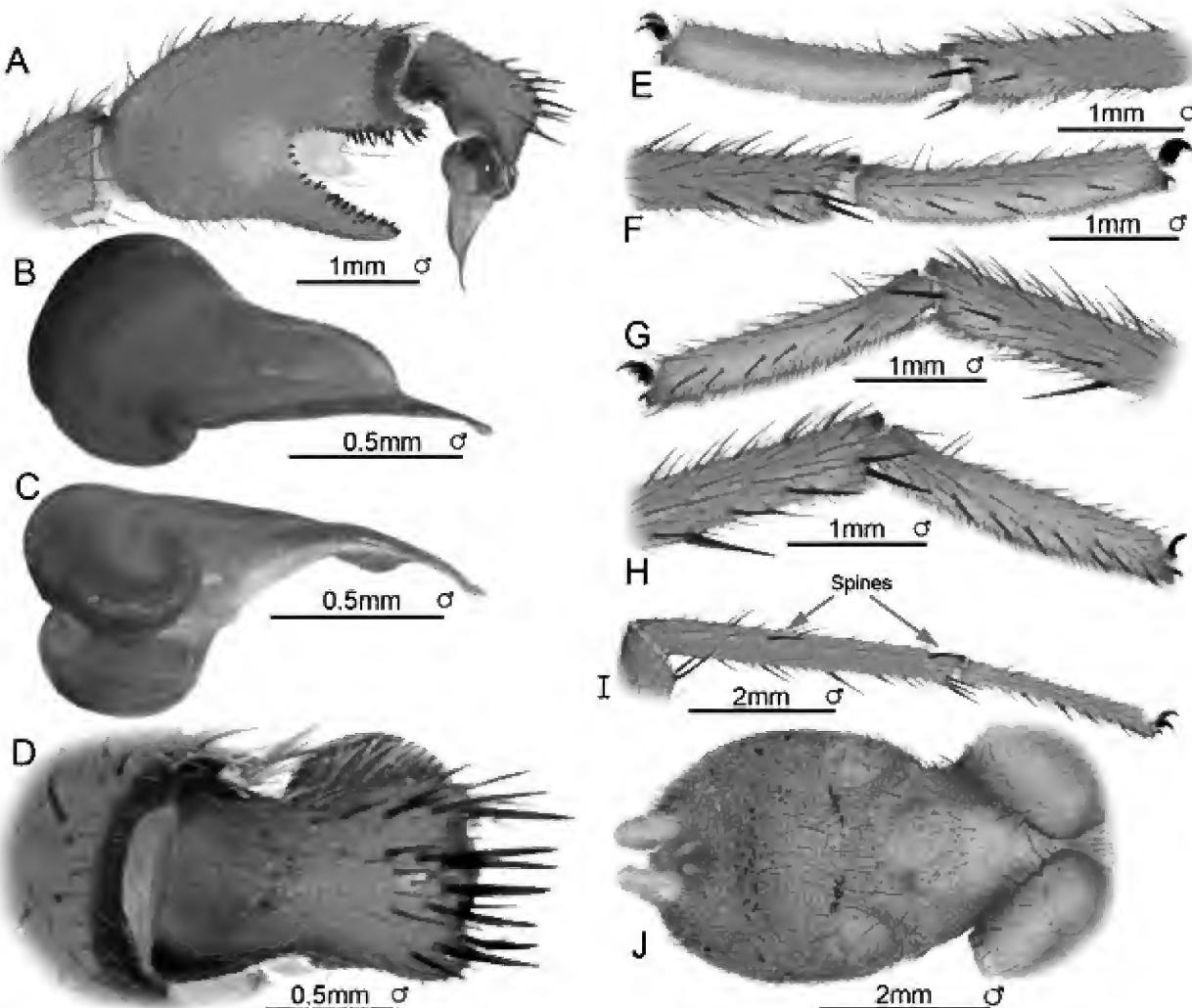


Fig. 18. *Misgolas baehrae* n.sp. A–I ♂, holotype AM KS48642; J ♂, paratype AM KS86224: (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (D), right cymbium dorsal. (E, F), right tarsus/metatarsus joint I: E, prolateral; F, retrolateral. (G, H), right tarsus/metatarsus joint II: G, prolateral; H, retrolateral. (I), right tarsus and metatarsus IV retrolateral. (J), venter.

### *Misgolas baehrae* n.sp.

Figs 18A–J, 24D

**Type material.** HOLOTYPE ♂, AM KS48642, Chichester State Forest 300, Karuah River Crossing, Karuah River Road (32°06'S 151°42'E), 4 Feb.–9 Apr. 1993, pit fall trap site 35AG, M. Gray, G. Cassis. PARATYPES ♂ ♂, AM KS86224, Chichester SF, 1.8 km north of ford on Karuah River Road (32°04'S 151°43'E), 4 Feb.–9 Apr. 1993, pit fall trap site 35AM, M. Gray, G. Cassis. AM KS86225, Chichester SF (NA), on Mountain Road, 0.2 km south of junction with Kunungra Road (32°08'S 151°44'E), 4 Feb.–9 Apr. 1993, pit fall trap site 35CR, M. Gray, G. Cassis. AM KS86226, Chichester SF (RM), 100 m north of trig. tower on Berrico Road (32°09'S 151°28'E), 4 Feb.–9 Apr. 1993, pit fall trap site 36CR, M. Gray, G. Cassis.

**Other material examined.** The specimens AM KS36701 (32°08'S 151°26'E), AM KS36703 (32°09'S 151°27'E), AM KS36711 (32°09'S 151°29'E), AM KS36712 (32°09'S 151°29'E) and AM KS38601 (32°10'S 151°28'E) collected c.

25 km west of type locality. Specimen AM KS86213 (Bulga State Forest, Homewoods Rd, 2.8 km west of Knodingbul Rd [31°37'S 152°07'E], 690 m, 4 Feb.–9 Apr. 1993, pit fall trap site 57CR, M. Gray, G. Cassis) collected c. 90 km Nor Nor West of type locality.

**Diagnosis.** In male: small sized tan spiders, carapace length c. 4.2–5.1; retrodorsal surface of metatarsi IV usually with two spines (Fig. 18I); venter pallid with dark brown pattern as figured (Fig. 18J). Palpal bulb retrolateral embolic flange with c. 6–7 fine folds; embolus straight, apophysis absent (Fig. 18B,C). Distal half of retroventral edge of tibial excavation to end of distal tibial apophysis suspends continuous brush of longer spines. Distal tibial apophysis straight horizontal. Cymbium bearing c. 14–20 long and attenuate spines projecting forward, almost horizontal (Fig. 18A,D). Conformation of palp as figured (Fig. 18A). Female not known.

### Description

**Male holotype** (Fig. 18A–J). **Size.** Carapace length 5.03, width 3.97. Abdomen length 4.61, width 2.64. **Colour.** In

alcohol all limbs and carapace medium tan; faint bilateral dark brown smudges on tibia, patella and femur of anterior limbs. Abdomen dorsum pallid densely mottled with dark brown; "chevrons" absent. Venter grey, apparently deteriorated, pattern not seen (discernible on paratype AM KS86224 as figured [Fig. 18J]). *Carapace*. Edge fringed with black bristles some extending onto post foveal surface. Line of c. 10 small bristles (some rubbed off) on caput arch. Group of four bristles between PME; group of 4 bristles on clypeus. Area extending onto pleuron below clypeus without setae. Fovea width 0.83, straight, deep, edges recurved, posterior wall centrally divided by pitted intrusion. *Eyes*. Raised on mound. Posterior half of ocular area adjacent to eyes black. Widths of anterior and posterior rows c. equal, 0.90 & 0.89 respectively. Eye group length 0.58, width/length ratio 1.55. Line joining posterior edges of ALE bisects AME. Posterior row straight in front, procurved behind. *Chelicerae*. Rastellum row of 6(5) spines; c. 5(5) smaller spines behind. Intercheliceral tumescence small, pallid. Fang groove with 7(7) promarginal teeth and 7(7) smaller retromarginal/intermediate row teeth. *Labium*. Bulbous, length 0.51, width 0.87. Labio-sternal suture broad, undivided. *Maxillae* c. 20(17) blunt cigar shaped anteroental cuspules. *Sternum*. Length 2.65, width 1.98. Sigilla all round; anterior pairs close to margin, posterior pair half diameter from margin. *Legs*. Tibia I with distal bifid apophysis; distal process with 2(2) short pointed spines, proximal process with 2(2) short blunt spines.

	palp	I	II	III	IV
femur	2.64	4.73	4.24	3.68	4.85
patella	1.18	2.27	2.15	1.78	2.33
tibia	2.61	3.44	3.19	2.27	4.61
metatarsus	—	3.62	3.13	2.94	4.42
tarsus	1.18	2.27	2.09	1.90	2.45
total	7.61	16.33	14.80	12.57	18.66

*Palp* (Fig. 18A). Cymbium with c. 7(8) large and 7(8) smaller attenuate spines projecting forward from anterior half of d surface. RTA covered with short pointed d spines which continue around and onto rv edge of tibial excavation; c. midway on rv edge spines become longer and continue to end of straight horizontal DTA forming an extended brush. TEM prominent, pallid, adjacent to RTA, TET on pl surface. *Bulb*. (Fig. 18B,C) Embolic rl flange with c. 7 folds, margin distally sharply convexly curved under embolus as if twisted. Embolus straight, apophysis absent. *Scopula*. Complete on tarsi I, weak and complete on tarsi II, weak & incomplete on metatarsi I and II, absent on legs III and IV. *Trichobothria*. Palp: tarsi 7, tibia pd 4, rd 5. Leg I: tarsi 10, metatarsi 9, tibia pd 6, rd 6. Leg II: tarsi 9, metatarsi 9, tibia pd 5, rd 5. Leg III: tarsi 9, metatarsi 6, tibia pd 5, rd 5. Leg IV: tarsi 10, metatarsi 11, tibia pd 6, rd 6. *Leg spination*. Leg I (Fig. 18E,F): tarsi rv line of 4 small spines adjacent scopula; metatarsi pv distal group of 3, rv distal group of 5; tibia v 0122. Leg II (Fig. 18G,H): tarsi bilateral rows small spines adjacent scopula pv 6, rv 9; metatarsi v 14; tibia v 0123. Leg III: tarsi v 18; metatarsi v 11, d 02220; tibia v 0113, pl 0110, rl 00110; patella pd 3. Leg IV (Fig. 18I): tarsi v 18; metatarsi v 14, rd 0010010; tibia v 6, rd 01010. *Abdomen*. Dorsum with c. 27 long brown bristles in a broad median band; smaller bristles evenly scattered with underlying small bristles and hairs. Venter with cover of small bristles.

**Etymology.** The species is named in recognition of arachnologist, Dr Barbara Baehr, at the Queensland Museum, Brisbane, Australia.

**Distribution and natural history** (Fig. 24D). This spider is known only from the Chichester and Bulga State Forests, localities c. 90 km apart. The burrow is unknown.

### *Misgolas macei* n.sp.

Figs 19A–F, 24D

**Type material.** HOLOTYPE ♂, AM KS38643, Bulga State Forest, Grey Gums Forest Road, 2.1 km from Doyles River Road (31°33'15"S 152°14'55"E), 560 m, 4 Feb.–9 Apr. 1993, pit fall trap site 57AG, M. Gray, G. Cassis.

**Diagnosis.** In male: medium sized dark tan spider, carapace length c. 5.77; retrodorsal surface of metatarsi IV with spines (Fig. 19E); venter entirely pallid (Fig. 19F). Palpal bulb (Fig. 19B,C) with broad retrolateral embolic flange with c. 8 minute folds; embolus with prolateral curve, apophysis absent. Palpal tibia and cymbium as figured (Fig. 19A,D), retrolateral tibial apophysis inclined downwards, length of retroventral edge of tibial excavation and distal tibial apophysis suspending continuous brush of spines; distal tibial apophysis with thickened base, straight, horizontal; Female not known.

### Description

**Male holotype** (Fig. 19A–F). *Size*. Carapace length 5.77, width 4.48. Abdomen length 5.21, width 3.07. *Colour*. In alcohol carapace, chelicerae and limbs dark tan, prosoma v surfaces paler. Dark brown smudges absent on limbs. Sparse cover of prostrate pallid hairs on caput, absent on limbs. Abdomen dorsum dark brown with 5 pallid transverse chevrons. Venter entirely pallid (Fig. 19F). *Carapace*. Edge with dense fringe black bristles; few encroach onto posterior half of post foveal surface. Line of 10 long median bristles on caput arch; transverse line of 3 bristles along anterior edge of fovea; 6 bristles between PME; 7 bristles on clypeus; 7 bristles on weakly chitinous pleuron below clypeus. Fovea width 0.95, straight, edges recurved; posterior wall not pitted. *Eyes*. Raised on mound. Area immediately adjacent to eyes black. Anterior width 1.02, posterior width 1.00, length 0.64, width/length ratio 1.59. Line joining posterior edges of ALE bisects AME. Posterior row straight in front, recurved behind. *Chelicerae*. Rastellum row of 6(6) spines; few smaller spines receding along anteroental edge of chelicerae. Intercheliceral tumescence small, swollen, pallid bearing sparse cover of minute brown setae. Fang groove with 7(7) promarginal teeth and 7(5) small retromarginal/intermediate row teeth. *Labium*. Bulbous, length 0.51, width 0.74. Labio-sternal suture divided centrally, broadening laterally. *Maxillae* c. 5(0) anteroental basally swollen setae taken to be elementary cuspules. *Sternum*. Length 3.36, width 2.25. Sigilla all small, round: Anterior pairs marginal, left posterior sigilla own diameter from margin, right posterior sigilla absent. *Legs*. Tibia I with distal bifid apophysis. Distal process with 2(2) short spines; proximal process with 3(3) longer, pointed spines.

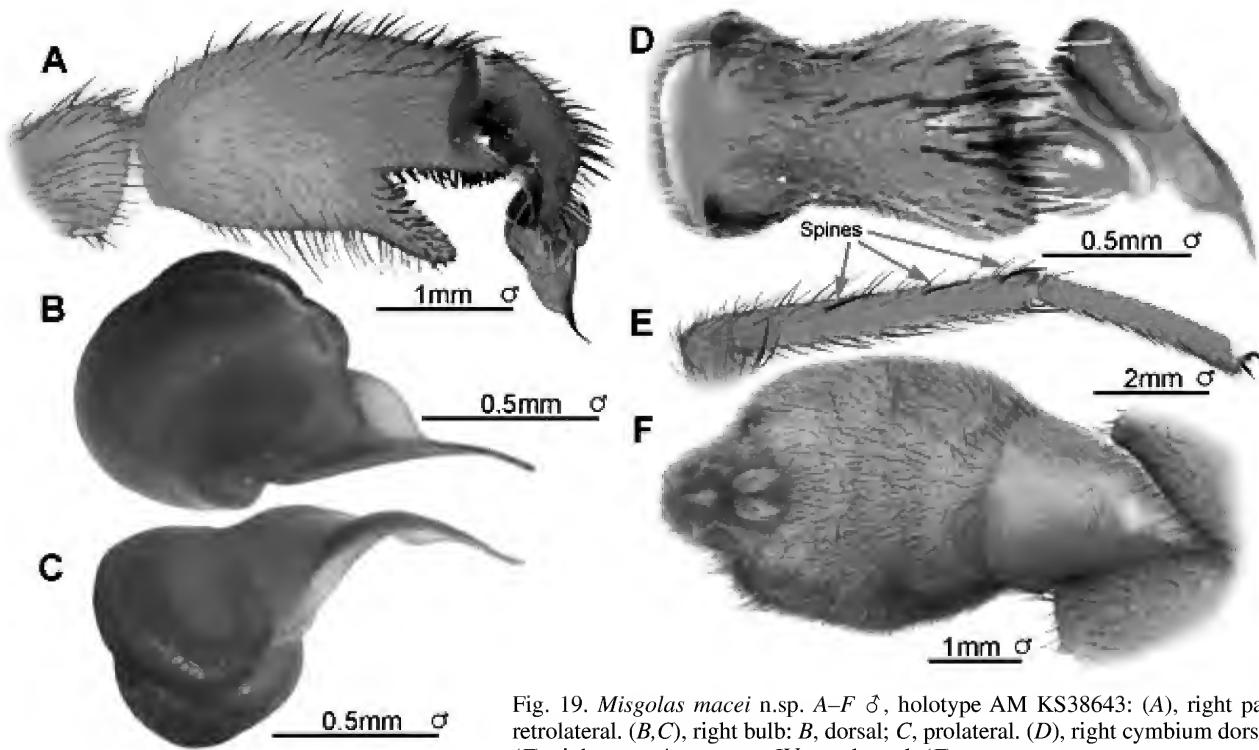


Fig. 19. *Misgolas macei* n.sp. A–F ♂, holotype AM KS38643: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D), right cymbium dorsal. (E), right tarsus/metatarsus IV retrolateral. (F), venter.

	palp	I	II	III	IV
femur	2.95	5.34	4.91	4.24	5.52
patella	1.47	2.76	2.45	2.03	2.76
tibia	2.52	3.62	3.44	2.70	4.97
metatarsus	—	3.62	3.25	3.44	4.85
tarsus	1.23	2.27	2.08	2.27	2.70
total	8.17	17.61	16.13	14.68	20.80

**Palp** (Fig. 19A,D). Cymbium with c. 24 long attenuate anteriorly inclined spines distributed over distal third of d surface. RTA with thickened base, inclined downwards, d and rd surfaces covered with squat pointed spines over its full length. Length of rv edge of tibial excavation to end of horizontal, non-digitate DTA, suspending continuous brush of spines. TEM absent, weak TET on pl surface of RTA. **Bulb**. (Fig. 19B,C) Broad embolic rl flange with c. 8 minute folds, margin convexly curved. Embolus gently pl curved from d aspect, narrow, apophysis absent. **Scopula**. Complete on tarsi I and II. Sparse distal remnants on metatarsi I and II, absent on legs III and IV. **Trichobothria**. Palp: tarsi 8, tibia pd 5, rd 6. Leg I: tarsi 11, metatarsi 10, tibia pd 5, rd 6. Leg II: tarsi 11, metatarsi 10, tibia pd 6, rd 6. Leg III: tarsi 12, metatarsi 11, pd 5, rd 6. Leg IV: tarsi 11, metatarsi 15, tibia pd 8, rd 6. **Leg spination**. Leg I: metatarsi pl 01, rv 011001; tibia rv 0111. Leg II: tarsi rl 1 subproximal (broken), 3 subdistal; metatarsi pv 0101 (both broken), rv 01 (broken) 1112 (both broken); tibia v 0111, pd 0110. Leg III: tarsi v 14; metatarsi v 02223, d 02220; tibia v 0122, pl 0110, rl 0110; patella pd 5 (2 broken). Leg IV (Fig. 19E): tarsi v 14; metatarsi v 9, rd 001110; tibia v 7, rd 0110. **Abdomen**. Dorsum covered with long dark brown bristles with underlying short setae. Venter covered with weak pallid bristles.

**Etymology**. The species is named in recognition of Mr Selwyn Mace, Gerringong resident and valued collector.

**Distribution and natural history.** (Fig. 24D). This spider is known only from the type locality, the Bulga State Forest, approximately 30 km ENE of the town of Comboyne, N.S.W. The burrow is unknown.

#### *Misgolas grayi* n.sp.

Figs 20A–I, 24D

**Type material.** HOLOTYPE ♂, AM KS86203, Gloucester Caves, N.S.W., Glow-worm Cave, Seive GL2 (32°25'S 151°41'E), 22 Jun.2003, M. Gray; holotype collected from burrow as penultimate juvenile 22 June 2003; reared to adult male 13 Oct. 2003. ALLOTYPE ♀, AM KS69976, data as for holotype. PARATYPE ♀: AM KS69977, data as for holotype.

**Diagnosis.** Small (male carapace length, c. 5.1) to medium (female carapace length, c. 6.6) light brown spiders; retrodorsal surface of metatarsi IV with weak spines, at least one midway (Fig. 20G); venter entirely pallid (Fig. 20E,F). Perimeter of ♂ carapace fringed with single orderly file black bristles (Fig. 20D), ♀ with weaker brown bristles (Fig. 20H). In male: palpal bulb (Fig. 20B,C) with retrolateral embolic flange with many extremely fine folds, distal edge curved under embolus; embolus tip twisted, with prolateral bend, embolic apophysis absent. Conformation of palp as figured (Fig. 20A). Burrow entrance as figured (Fig. 20I).

#### Description

**Male holotype** (Fig. 20A–E). **Size.** Carapace length 5.15, width 3.99. Abdomen length 4.24, width 2.95. **Colour.** In alcohol carapace, legs, palps and chelicerae light tan; dark brown smudges absent from lateral limb surfaces. Few sparse pallid hairs on caput, absent on limbs. Abdomen dorsum

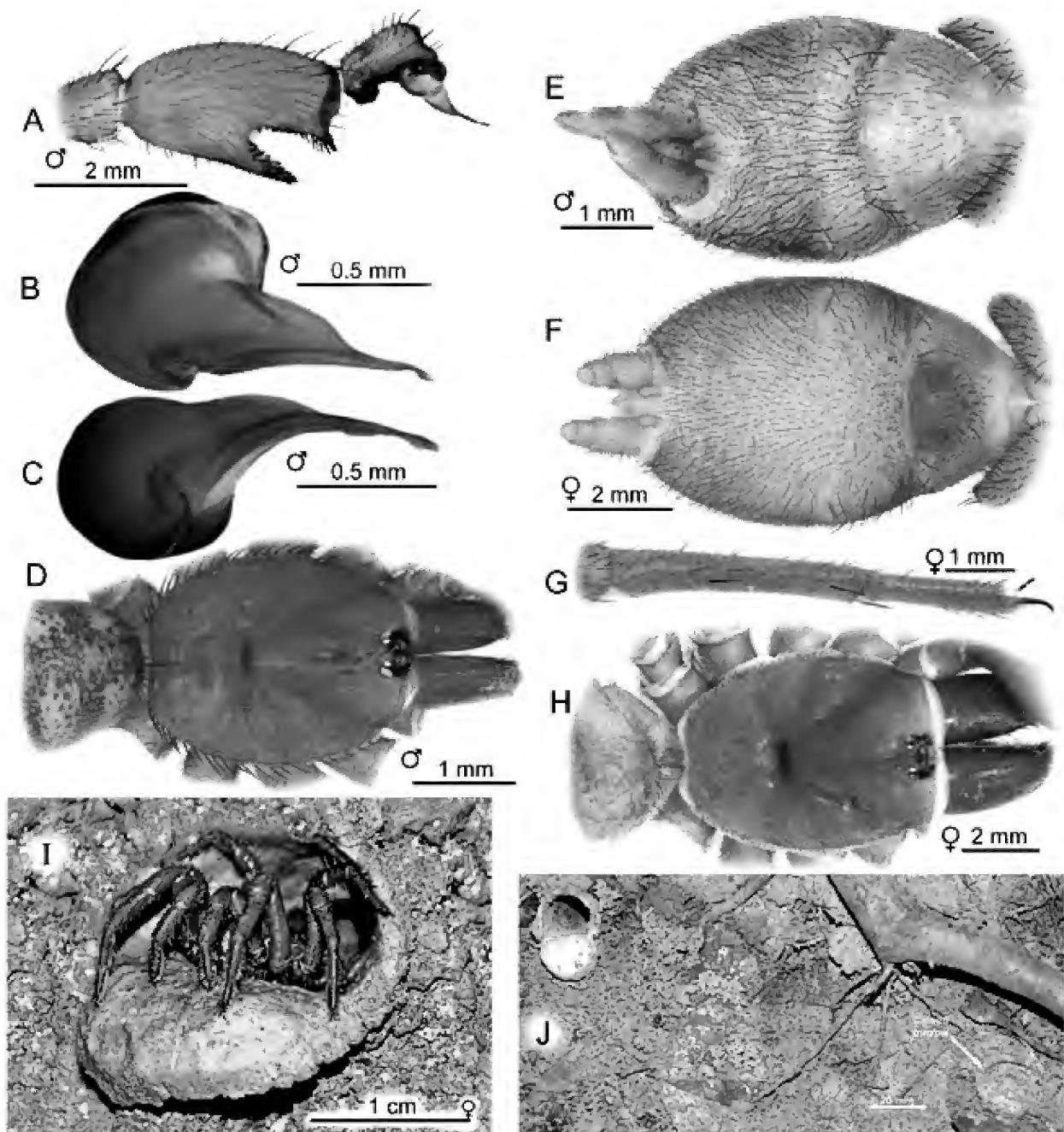


Fig. 20. *Misgolas grayi* n.sp. A–E ♂, holotype AM KS86203: (A) right palp retro-lateral. (B, C) right bulb: B, dorsal; C, prolateral. (D) carapace. (E) venter. (F–J) ♀, allotype AM KS69976: F, venter; G, right tarsus and metatarsus IV retrodorsal; H, carapace; I, spider at burrow entrance (photo by Garry K. Smith). (J), burrows of unidentified spiders at Wootton, NSW.

dark brown, with broad pallid chevrons in bilateral series of six. Venter entirely pallid (Fig. 20E). *Carapace*. (Fig. 20D) Entire edge fringed with single orderly file of black bristles, c. 10, encroach onto the post foveal surface. Rows of 3 or 4 black bristles along each stria; row of 6 on caput arch. Group of 3 bristles between PME. Group of 5 bristles on clypeus. Area extending onto pleuron below clypeus only slightly chitinous and bearing one hair. Fovea width 0.77, straight with recurved edges, posterior wall not pitted. *Eyes*. AME raised on pronounced mound, area surrounding anterior row black. Anterior and posterior row widths equal, 0.89, length 0.64, width/length ratio 1.39. Line joining posterior edge of ALE transects anterior third of AME. Posterior row straight

in front, recurved behind. *Chelicerae*. Rastellum a single row of 5(6) weak spines; posterior spines absent. Intercheliceral tumescence entirely pallid, each covered with c. 17 setae. Fang groove with 9(9) promarginal teeth, 7(7) smaller retro-marginal/intermediate row teeth. *Labium*. Slightly bulbous, twice as wide as long, length 0.53, width 1.04. Labio-sternal suture narrow, centrally divided. *Maxillae* c. 10(18) small, stick-like antero-ventral cuspules. *Sternum*. Length 2.58, width 2.03. Sigilla all small, round. Anterior pairs submarginal, posterior pair c. its own diameter from margin. *Legs*. Tibia I with distal bifid apophysis; distal process with 2(2) straight pointed spines, proximal process with 3(3) longer curvilinear pointed spines.

	palp	I	II	III	IV
femur	2.84	4.97	4.67	3.99	5.16
patella	1.33	2.33	2.09	1.84	2.33
tibia	2.71	3.56	3.44	2.58	4.54
metatarsus	—	3.68	3.50	3.38	4.91
tarsus	1.15	2.21	2.15	2.07	2.58
total	8.03	16.75	15.85	13.86	19.52

**Palp** (Fig. 20A). Cymbium with c. 18 long, attenuate, anteriorly inclined spines distributed over distal half of d surface. RTA digitate, without swelling, almost horizontal, covered with squat pointed d and rd spines. Smaller spines on proximal half of rv edge of tibial excavation; c. 18 longer spines on distal half continuing onto short, straight DTA parallel to RTA. TEM small, pointed, adjacent to RTA. TET not seen. **Bulb.** (Fig. 20B,C) Embolic rl flange with many extremely fine folds, gently convexly curved, distal edge curved under embolus. Embolic apophysis absent; tip twisted and with pl bend. **Scopula.** Complete, sparse and weak on tarsi I and II, a few apical scopula setae on metatarsi I and II; absent on legs III and IV. **Trichobothria.** Palp: tarsi 7, tibia pd 5, rd 6. Leg I: tarsi 10, metatarsi 11, tibia pd 6, rd 5. Leg II: tarsi 10, metatarsi 10, tibia pd 6, rd 6. Leg III: tarsi 11, metatarsi 10, tibia pd 5, rd 6. Leg IV: tarsi 10, metatarsi 12, tibia pd 7, rd 6. **Leg spination.** Leg I: tarsi pv 0110, rv 01110; metatarsi pv 0011, rv 0112; tibia rv 0112, pl 010. Leg II: tarsi pv 00111010; metatarsi v 12 scattered; tibia v 0112, pd 0110; Leg III: tarsi v 12 scattered; metatarsi v 10 scattered, d 002220; tibia v 0113, d 03320; patella pd 3. Leg IV: tarsi v 10 scattered; metatarsi v 10 scattered, rd 010; tibia v 6 scattered, rl 0110. **Abdomen.** Dorsum with cover of long dark brown bristles, longer on anterior surface. Smaller bristles extend to and become abundant on venter. Underlying fine setae absent.

**Female allotype.** (Fig. 20F–H). **Size.** Carapace length 6.57, width 3.99. Abdomen length 7.74, width 2.95. **Colour.** In alcohol carapace, legs, palp and chelicerae as for male. Dark brown smudges absent from lateral limb surfaces. Very few fine pallid hairs on caput, absent on limbs. Abdomen dorsum deteriorated, dorsum of paratype AM KS69977 as for male. Venter entirely pallid. **Carapace.** (Fig. 20H) Bristle arrangement similar to and as for male excepting bristles reduced in size. Group of 7 on clypeus. Area extending onto pleuron below clypeus not chitinous, with 1 large and 2 small bristles. Fovea width 0.98, deep, straight with recurved edges, posterior wall centrally divided by small pitted intrusion. **Eyes.** AME and PME placed on mound. Area immediately surrounding eye margins black. Anterior width 1.13, posterior width 1.15, length 0.69, width/length ratio 1.67. Line joining posterior edge of ALE transects anterior quarter of AME. Posterior row procurved in front, recurved behind. **Chelicerae.** Rastellum front row of 7(7) strong spines, 2(2) spines behind. Fang groove with 9(10) promarginal teeth and 13(11) smaller retromarginal/intermediate row teeth. **Labium.** Broad, bulbous, length 0.82, width 1.33. Labio-sternal suture as for male. **Maxillae** c. 44(42) short blunt anteroental cuspules. **Sternum.** Length 3.55, width 2.80. Sigilla as for male. Anterior pair its own diameter, midpair 1.5 diameters and posterior pair 2 diameters from margin. **Legs.**

	palp	I	II	III	IV
femur	3.99	5.16	4.54	3.67	5.26
patella	2.21	2.88	2.70	2.29	3.07
tibia	2.64	3.31	2.94	2.09	4.42
metatarsus	—	2.76	2.64	2.53	4.11
tarsus	2.64	1.72	1.66	1.70	2.08
total	11.48	15.83	14.48	12.28	18.94

**Scopula.** Complete on palpal tarsi, complete and weak on tarsi I and II, few distal scopula setae on metatarsi I and II; absent on legs III and IV. **Trichobothria.** Palp: tarsi 8, tibia pd 6, rd 6. Leg I: tarsi 12, metatarsi 11, tibia pd 7, rd 6. Leg II: tarsi 13, metatarsi 11, tibia pd 7, rd 7. Leg III: tarsi 12, metatarsi 9, tibia pd 6, rd 7. Leg IV: tarsi 11, metatarsi 15, tibia pd 8, rd 7. **Leg spination.** Palp: tarsi pl 110000, rl 110000; tibia v 0222, rv 01110, pl 00011. Leg I: tarsi 1 sub-distal; metatarsi v 11 scattered; tibia v 011113. Leg II: tarsi rv 6 scattered on distal half; metatarsi v 11 scattered; tibia v 0011113. Leg III: tarsi v 8 scattered; metatarsi v 10 scattered, d 02220; tibia v 0113, pd 0110, rd 0110; patella pd 3. Leg IV: (Fig. 20G) tarsi v 9 scattered on distal two-thirds; metatarsi v 01213, rd 01010; tibia v 7 scattered. **Abdomen.** Dorsum with sparse cover of weak dark brown bristles most concentrated and longer on median surface; longest bristles on anterior surface. Shortest bristles abundant on venter. Understory of fine setae absent. **Genitalia.** Sclerous lip of epigynum straight.

**Etymology.** The species is named in recognition of Dr Michael R. Gray, arachnologist and one time head Division of Invertebrate Zoology, Australian Museum, Sydney and collector of type material of this spider.

**Distribution and natural history.** (Fig. 24D) Known only from the type locality, cave entrance approximately 7 km WSW of the town of Dungog, N.S.W.

Burrow entrance with lid conserved: Dry collection AM KS86204, from type locality.

The collector of the type specimens reports the burrows excavated were from damp mud walls in dark zone near cave entrance. The trapdoor opens downwards, spider rests on door when hunting (Fig. 20I). Trapdoor is of mud, plug-like.

One of us (GW) has been made aware (H. Smith, pers. comm., 13 July 2007) of a 1922 record of burrows with similar entrances to that described above and situated at Wootton, NSW, about 60 km East of the type locality of *M. grayi* (Papers of Sidney William Jackson, National Library of Australia, MS466, Series 3 Field trip books, 1908–1922, Folder 167–171, Woolton (sic) and Wallis Lake Trip, 26 September–2 December 1922). More burrows have now been found in the Wootton locality (GW, 3 Aug. 2007, Coolongolook River, Wootton, N.S.W., 100 m North of bridge, on West bank [32°17'48"S 152°17'55"E]) and are as described by Jackson (Fig. 20J). The identity of the spider has not been determined.

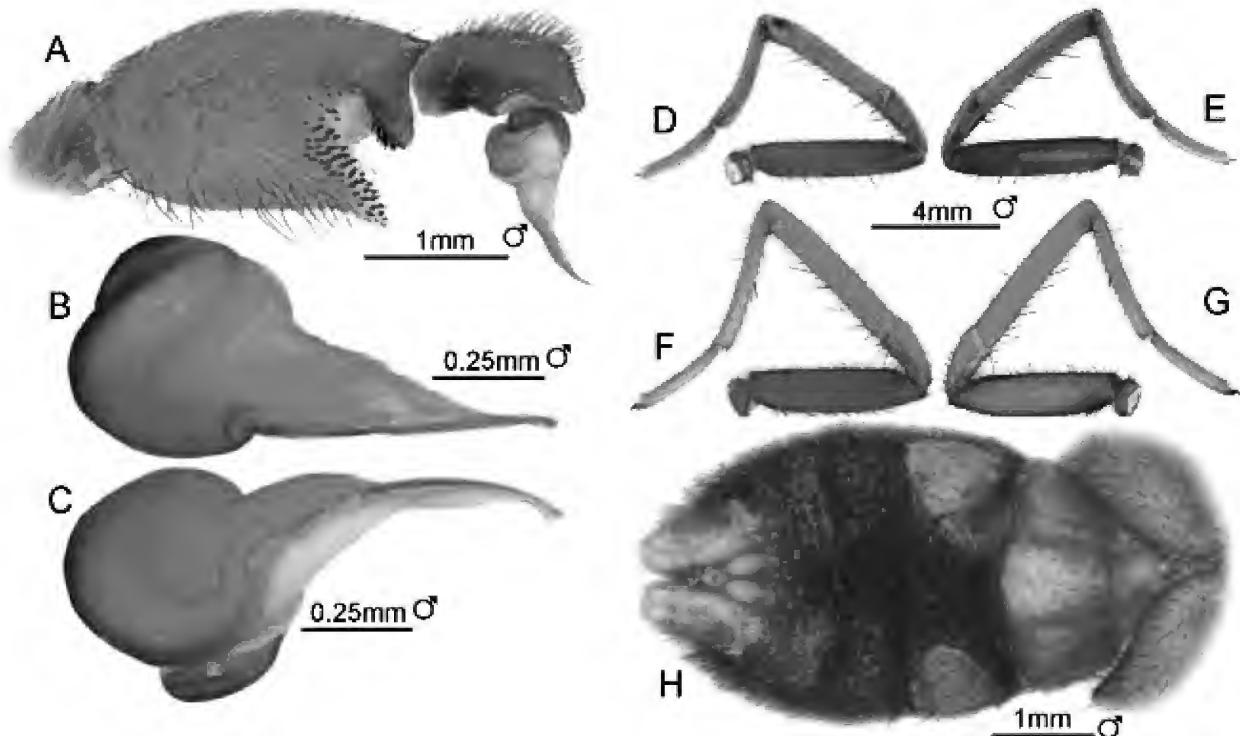


Fig. 21. *Misgolas brownningi* n.sp. A–C, H ♂, paratype AM KS5418. (A), right palp retrolateral. (B, C), right bulb: B, dorsal; C, prolateral. (H), venter. D–G ♂, holotype AM KS5437: (D, E), right leg I: D, prolateral; E, retrolateral. (F, G), right leg IV: F, prolateral; G, retrolateral.

### *Misgolas brownningi* n.sp.

Figs 21A–H, 24D

**Type material.** HOLOTYPE ♂, AM KS5437, Kerewong State Forest, nr Lorne, site 108(3) (31°36'S 152°34'E), 15 July 1979, pit fall trap field No. 1598, set 30 May 1979, collected 1 Sep. 1979, D. Milledge. PARATYPES. ♂♂: AM KS5407, Kerewong SF, nr Lorne, site 108(1) (31°36'S 152°34'E), 15 July 1979, pit fall trap field No. 1596, set 30 May 1979, collected 1 Sep. 1979, D. Milledge. AM KS5418, Kerewong SF, nr Lorne, site 108(2) (31°36'S 152°34'E), 15 July 1979, pit fall trap field No. 1597, set 30 May 1979, collected 1 Sep. 1979, D. Milledge. All type specimens brittle and easily damaged, possibly first preserved in formalin.

**Diagnosis.** In male: small dark tan spider, carapace length c. 4.50; retrodorsal surface of metatarsi IV without spines (Fig. 21G); venter entirely dark brown (Fig. 21H). All tarsi without spines (Fig. 21D–G). Palpal bulb (Fig. 21B, C) retrolateral embolic flange with 3 prominent and c. 3–4 minor folds, margin straight; embolic apophysis absent. Palp as figured (Fig. 21A), retrolateral tibial apophysis short, stout; distal tibial apophysis enlarged, cymbium dorsal surface with dense cover of weak bristles and long pallid hair. Female not known.

### Description

**Male holotype** (Fig. 21A–H). **Size.** Carapace length 4.48, width 3.68. Abdomen length 4.54, width 2.77. **Colour.** In alcohol carapace, chelicerae and all femora dark brown; distal limb segments light tan. Pallid hairs on carapace concentrated on caput and carapace perimeter, extending

onto chelicerae and proximal limb segments. Elongate dark brown bilateral smudges most pronounced on anterior limbs, reduced on posterior limbs (Fig. 21D–G). Abdomen dorsum dark brown with 6 pallid transverse chevrons; venter entirely dark brown (Fig. 21H). **Carapace.** Edge fringed with black bristles which encroach onto posterior half of post foveal surface. Line of 6 bristles on caput arch. Group of 6 small bristles with many fuscous hairs on clypeus. Area on pleuron membrane below clypeus free of chitin and setae. Fovea width 0.92, straight, deep, recurved edges; posterior wall not pitted. **Eyes.** Raised on mound. Area adjacent to eyes black; anterior width 1.05, posterior width 0.87, length 0.55, width/length ratio 1.91. Line joining posterior edge of ALE bisects AME. Posterior row recurved in front, straight behind. **Chelicerae.** Rastellum row of 5(5) spines, 2(3) behind. Fang groove teeth and intercheliceral tumescence detail not visible without damaging chelicerae. **Labium.** Bulbous. Length 0.51, width 0.79. Labio-sternal suture broad, continuous, straight, extremities procurved. **Maxillae** c. 27(27) squat, pointed anteroventral cuspules. **Sternum.** Bulbous, not elongate, almost round. Length 2.48, width 2.00. Sigilla round: anterior pair small, marginal; mid pair small, own diameter from margin; posterior pair larger, twice diameter from margin. **Legs.** Right leg III missing. Tibia I with distal bifid apophysis. Distal process with 2(1) short spines, proximal process with 2(1) long spines. All inferior third claws reduced or lost.

	palp	I	II	III	IV
femur	2.64	5.22	4.66	(3.47)	5.03
patella	1.15	2.39	2.09	(1.60)	2.21
tibia	2.29	4.18	3.56	(2.21)	4.79
metatarsus	—	3.62	3.13	(2.82)	4.24
tarsus	1.03	2.28	2.03	(1.91)	2.46
total	7.11	17.69	15.47	(12.01)	18.73

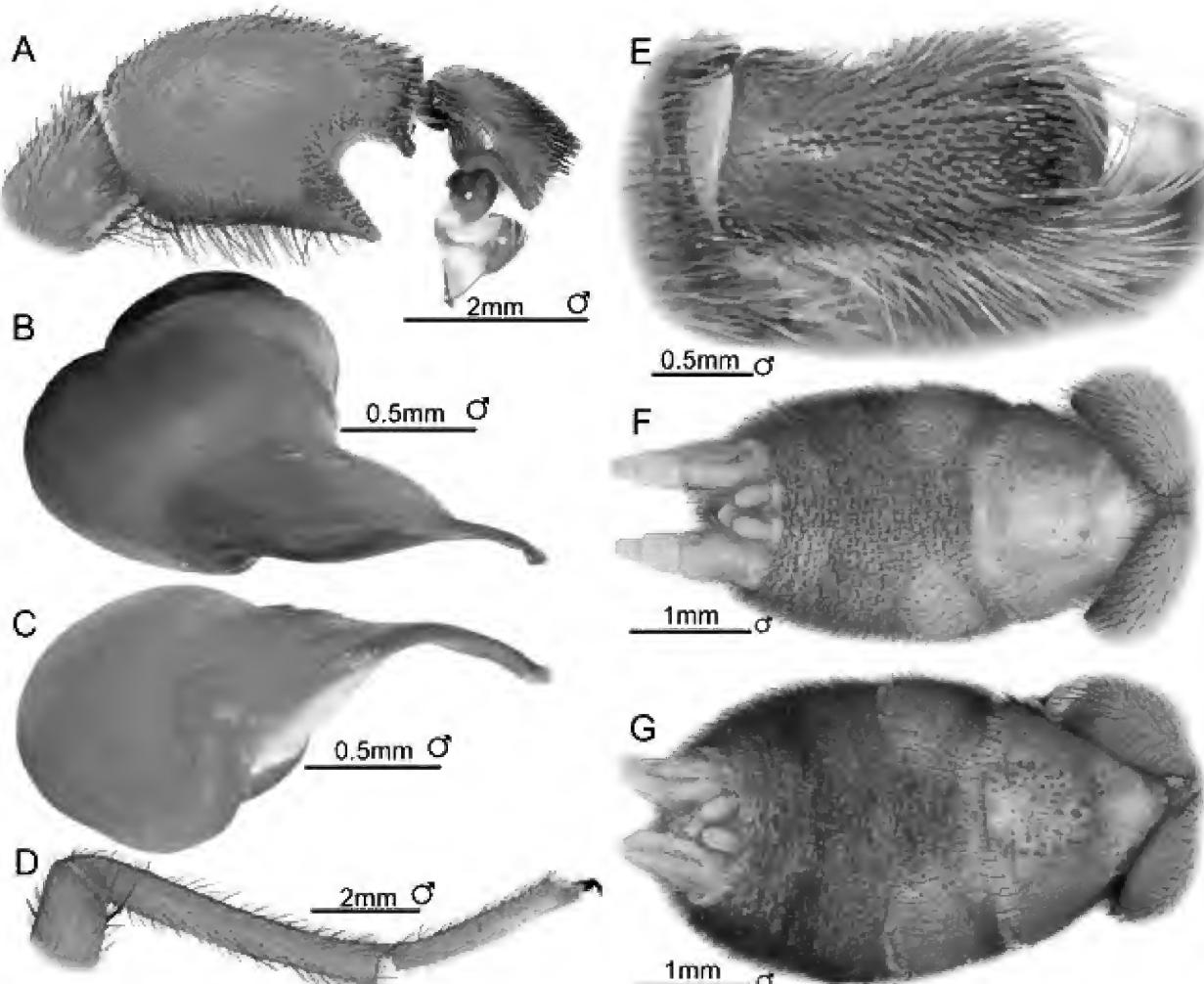


Fig. 22. *Misgolas linklateri* n.sp. A, E, G ♂, paratype AM KS5383: (A), right palp retrolateral. (E), right cymbium dorsal. (G), venter. B, C, D, F ♂, holotype AM KS5460: (B, C), right bulb; B, dorsal; C, prolateral. (D), right tarsus and metatarsus IV retrolateral. (F), venter.

**Palp** (Fig. 21A). Cymbium d surface with dense cover of weak bristles and long prostrate pallid hair; spines absent. RTA short, stout, with cover of short rd spines which continue along rv edge of tibial excavation and onto a bulky, almost vertically suspended, DTA. TEM large, pallid, contiguous with RTA, pl surface with prominent TET. **Bulb** (Fig. 21B,C) Embolic rl flange with 3 prominent plus 2 minor folds, margin straight, occupying almost entire length of straight embolus. Embolic apophysis absent. **Scopula**. Complete on all tarsi. Progressively weaker and incomplete on metatarsi. **Trichobothria**. Palp: tarsi 8, tibia pd 4, rd 5; Leg I: tarsi 10, metatarsi 12, tibia pd 6, rd 5; Leg II: tarsi 9, metatarsi 10, tibia pd 6, rd 5; Leg III: tarsi (9), metatarsi (9), tibia pd (5), rd (5); Leg IV: tarsi 10, metatarsi 9, tibia pd 6, rd 6. **Leg spination**. (Fig. 21D–G) Absent on all tarsi. Leg I: tibia v 01112. Leg II: metatarsi v 010, tibia v 01113. Leg III: metatarsi (d 0020020), tibia (rl 010, v 0113), patella pd (5). Leg IV: metatarsi v 01200, tibia v 0111. **Abdomen**. Dorsum covered with long brown bristles. Venter covered with shorter, weaker, brown bristles.

**Etymology**. The species is named in recognition of assistance given to GW by Mr George Browning of Coogee, NSW.

**Distribution and natural history.** (Fig. 24D) This spider is known only from the type locality, the Kerewong State Forest near the town of Lorne, N.S.W. The burrow is unknown.

#### *Misgolas linklateri* n.sp.

Figs 22A–G, 24D

**Type material.** HOLOTYPE ♂, AM KS5460, Kerewong State Forest, nr Lorne, site 108(2) (31°36'S 152°34'E), 15 July 1979, pit fall trap field No. 1597, litter, set 30 May 1979, collected 1 Sep. 1979, D. Milledge. PARATYPE ♂, AM KS5383, Lorne State Forest, nr Lorne, site 86(3) (31°35'S 152°37'E), 15 July 1979, pit fall trap field No. 1593, litter, set 30 May 1979, collected 1 Sep. 1979, D. Milledge. Type specimens, possibly first preserved in formalin, brittle and easily damaged.

**Diagnosis.** In male: medium sized dark tan spider, carapace length c. 7.25–7.8; retrodorsal surface of metatarsi IV without spines (Fig. 22D); venter as figured (Fig. 22F,G). Spines absent on all tarsi. Palpal bulb (Fig. 22B,C) retrolateral embolic flange as figured with c. 6 folds plus c. 3 minor

folds; embolus with prolateral curve, apophysis absent. Palp as figured (Fig. 22A,E); retrolateral tibial apophysis short, stout; distal tibial apophysis small, digitate. Cymbium dorsal surface with dense cover of short blunt sub-erect spines.

## Description

**Male holotype** (Fig. 22A–G). *Size.* Carapace length 7.25, width 6.08. Abdomen length 7.18, width 4.36. *Colour.* In alcohol chelicerae, carapace and all femora dark tan; distal limb segments lighter, dark brown smudges absent. Pallid hairs on caput; sparse cover on inter stria and proximal limb segments. Abdomen dorsum dark brown with 6 inconspicuous pallid transverse chevrons. Venter pallid with many dense, evenly distributed dark brown small speckles (Fig. 22F), tending to be most dense along median band and central transverse band (refer paratype AM KS5383, [Fig. 22G]). *Carapace.* Edge fringed with black bristles which encroach onto posterior half of post foveal surface. Line of c. 18 weak median bristles on caput arch (some rubbed off); group of c. 12 between PME, 9 longer bristles and some weak setae on clypeus; c. 12 fine setae on weakly chitinous pleuron membrane below clypeus. Fovea width 1.41, straight, deep; posterior wall basally centrally divided by small pitted intrusion. *Eyes.* Raised on mound. Area immediately adjacent to eyes black; anterior width 1.34, posterior width 1.18, length 0.70, width/length ratio 1.91. Line joining posterior edges of ALE bisects AME. Posterior row straight in front, recurved behind. *Chelicerae.* Rastellum row of 7(7) spines, 6(6) smaller spines behind. Fang groove teeth and intercheliceral tumescence detail not visible without damaging chelicerae. *Labium.* Low. Length 0.87, width 3.19. Labio-sternal suture broad, narrowed centrally, continuous. *Maxillae* c. 28(28) small anteroventral cuspules all surmounted by a fine hair. *Sternum.* Length 3.99, width 3.19. Sigilla round; anterior and mid pairs small, one diameter from margin; posterior pair larger, two diameters from margin. *Legs.* Tibia I with distal bifid apophysis. Distal process with 2(3) short spines, proximal process with 2(2) longer spines.

	palp	I	II	III	IV
femur	4.48	7.12	6.14	4.79	6.93
patella	2.29	3.50	3.25	2.52	3.38
tibia	3.51	5.28	4.48	2.76	6.08
metatarsus	—	5.28	4.54	3.99	6.02
tarsus	1.94	3.07	2.82	2.52	3.01
total	12.22	24.25	21.23	16.58	25.42

*Palp* (Fig. 22A,E). Cymbium with bilateral brushes of long, pallid setae; c. 200 short blunt sub-erect spines distributed over distal five-sixths of d surface. Short, stout RTA, rd surface covered with squat pointed spines continuing along rv edge of tibial excavation onto DTA. DTA digitate, directed almost vertically downwards. TEM swollen, not pointed, contiguous with RTA, pl face chitinous bearing prominent TET. *Bulb*. (Fig. 22B,C). Embolic rl flange with c. 6 folds plus c. 3 minor folds, margin gently curved, distally folded under pl curved embolus. Embolic apophysis absent, embolus tip complex. *Scopula.* Complete on all tarsi. Progressively weaker and reduced from metatarsi I to metatarsi IV. *Trichobothria.* Palp: tarsi 8, tibia pd 6, rd 5. Leg I: tarsi 12, metatarsi 12, tibia pd 6, rd 6. Leg II: tarsi 11, metatarsi 12, tibia pd 6, rd 6. Leg III: tarsi 10, metatarsi 8,

tibia pd 6, rd 6. Leg IV: tarsi 12, metatarsi 11, tibia pd 6, rd 7. *Leg spination.* Absent on all tarsi. Leg I: tibia v 0111111. Leg II: metatarsi v 010; tibia v 0112. Leg III: metatarsi pd 0111110, rd 000110; tibia v 0113, pl 001110, rl 011; patella pd 10. Leg IV: (Fig. 22D) metatarsi v 010111; tibia v 012. *Abdomen.* Dorsum covered with long dark bristles with underlying prostrate pallid hairs. Venter covered with shorter weaker brown bristles.

**Etymology.** The species is named in recognition of neighbour and mentor, Dr Peter Linklater of Gerringong, NSW.

**Distribution and natural history.** (Fig. 24D) This spider is known only from the type localities, the Kerewong and Lorne State Forests near the town of Lorne, NSW. The burrow is unknown.

## *Misgolas chisholmi* (Hickman, 1933) identity uncertain

This spider is known only from the type locality, described as the town of “Comboyne, New South Wales” (31°35'S 152°28'E), a locality within the geographical bounds of this work (Fig. 24B). Because the type material is female with attendant character poor morphology it presently is not assigned an identity (Wishart, 2006).

## *Misgolas milledgei* n.sp.

Fig. 23A–H

**Type material.** HOLOTYPE ♂, AM KS21570, Bondi, Eastern suburb of Sydney, (33°53'S 151°17'E), 4 Apr. 1989, J. Weiss, found wandering in house.

**Diagnosis.** In male: Large sized dark brown spider, carapace length c. 8.5–9, retrodorsal surface of metatarsus IV without spines (Fig. 23G); venter pale with dark brown maculations in median and a transverse bands (Fig. 23E). Spines absent on tarsi I–III, row of 2–3 on proventral surface tarsi IV (Fig. 23F). Palpal bulb retrolateral embolic flange with c. 8 distinct folds; embolus as figured (Fig. 23B,C). Cymbium dorsal surface with many crowded short blunt sub-erect spines (Fig. 23H). Conformation of palpal tibia as figured (Fig. 23A). Female not known.

## Description

**Male holotype** (Fig. 23A–H). *Size.* Carapace length 8.72, width 7.06. Abdomen length 7.74, width 5.29. *Colour.* In alcohol carapace, limbs and chelicerae dark brown; darker brown limb smudges absent. Carapace and limbs with few sparse golden hairs. Abdomen dorsum dark brown with c. 6 pallid transverse chevrons (Fig. 23D). Venter pallid with some dark brown maculations forming median and central transverse bands (Fig. 23E). *Carapace.* (Right anterior segment of carapace damaged) Edge fringed with black bristles which encroach onto posterior quarter of post foveal surface. Few weak black inter-strial bristles. Row of c. 16 black bristles on caput arch; 11 between PME; 21 on clypeus. Weakly chitinized area on pleuron membrane

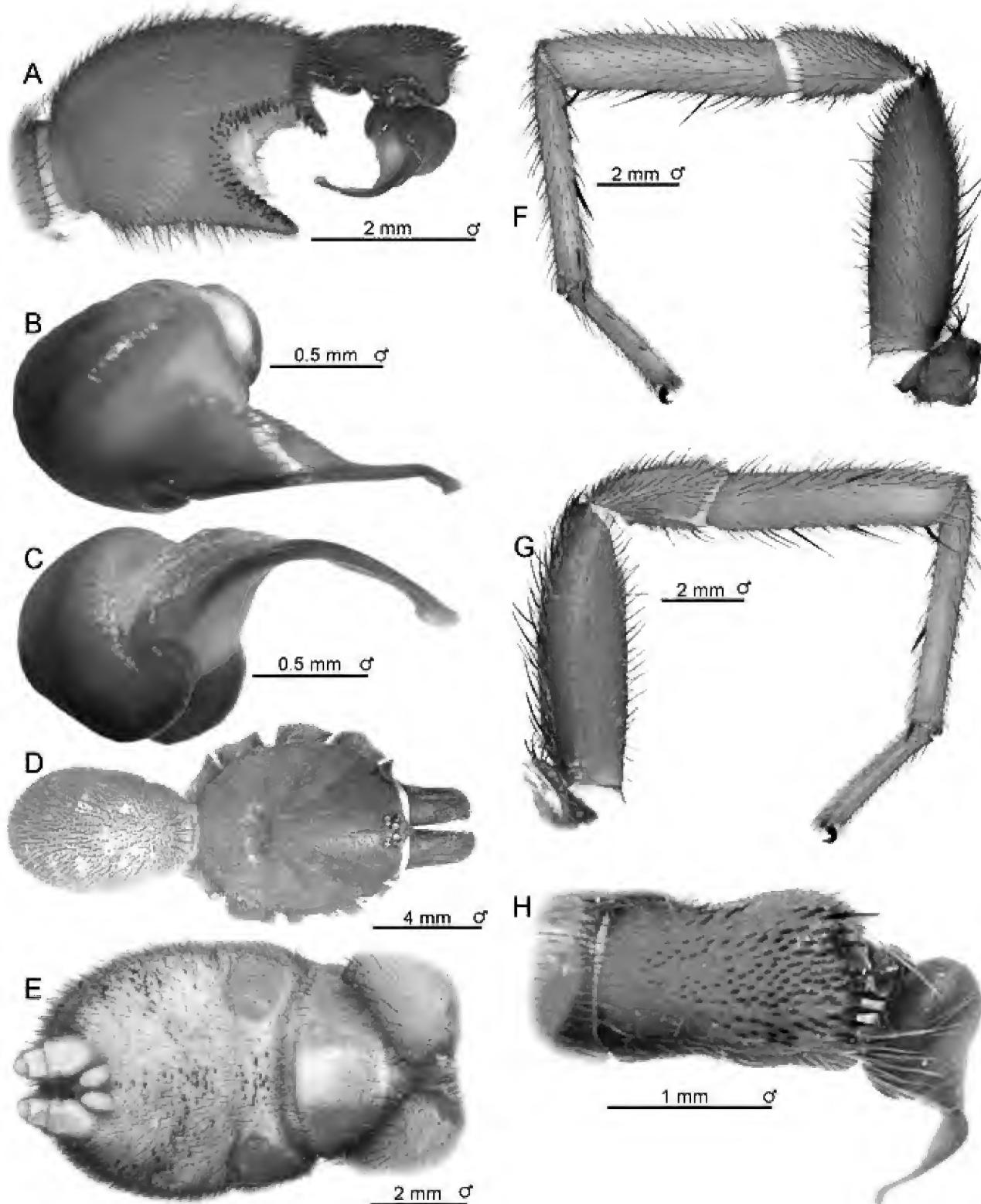


Fig. 23. *Misgolas milledgei* n.sp. A–H ♂, holotype AM KS21570: (A), right palp retrolateral. (B,C), right bulb: B, dorsal; C, prolateral. (D), body dorsum. (E), venter. (F,G), right leg IV: F, prolateral; G, retrolateral. (H), right cymbium dorsal.

below clypeus with 3 bristles and few fine setae. Fovea width 1.69, recurved, posterior wall centrally divided by minute pitted intrusion. *Eyes*. Raised on mound. Ocular area darker adjacent to eyes. Anterior width 1.36, posterior width 1.25, length 0.77, width/length ratio 1.77. Line joining posterior edges of ALE bisects AME. Posterior row straight in front,

recurved behind. *Chelicerae*. Rastellum first row 7(6) strong spines, few smaller spines scattered behind. Intercheliceral tumescence small, indistinct. Fang groove with 9(9) promarginal teeth, 9(12) smaller retromarginal/intermediate row teeth. *Labium*. Bulbous, length 1.05, width 1.31. Labiosternal suture narrowed medially, continuous. *Maxillae* c. 12(16)

reduced or elementary anteroventral cuspules appearing as thickened setae. *Sternum*. Length 4.42, width 3.68. Sigilla first and second pair small, round; third pair larger, ovate; first pair one diameter from margin, second pair twice its diameter from margin, third pair twice its length from margin. *Legs*. Tibia I with distal bifid apophysis; distal process with 2(2) blunt compact spines, proximal process with row of 3(3) longer pointed compact spines.

	palp	I	II	III	IV
femur	4.42	7.37	6.63	5.34	7.18
patella	2.49	3.99	3.62	2.95	3.62
tibia	3.56	4.85	4.42	4.18	5.83
metatarsus	—	5.77	4.91	4.24	6.39
tarsus	1.66	3.19	3.01	2.58	3.07
total	12.13	25.17	22.59	19.29	26.09

*Palp* (Fig. 23A). Cymbium with many crowded short blunt sub-erect spines distributed on distal four-fifths of d surface. RTA short, pointed; d surface covered with short pointed spines which continue uninterrupted along rv edge of tibial excavation terminating at DTA end. DTA straight, inclined downwards. TEM prominent, pallid, adjacent to RTA, pl surface with indistinct TET. *Bulb* (Fig. 23B,C). Embolic rl flange with 8 distinct folds; margin straight. Embolus tip with pl bend from d aspect, suspending thin translucent flange from pl aspect. Embolic apophysis absent. *Scopula*. Complete on tarsi I and II; weaker, incomplete on metatarsi I and II; weaker, complete on tarsi III and IV; sparse distal remnants on metatarsi III and IV. *Trichobothria*. Palp: tarsi 9, tibia pd 5, rd 5. Leg I: tarsi 12, metatarsi 15, tibia pd 7, rd 7. Leg II: tarsi 11, metatarsi 13, tibia pd 6, rd 6. Leg III: tarsi 10, metatarsi 8, tibia pd 4, rd 7. Leg IV: tarsi 13, metatarsi 17, tibia pd 7, rd 7. *Leg spination*. Leg I: metatarsi rv 0100; tibia v 0112. Leg II: metatarsi rv 01101; tibia v 01102. Leg III: metatarsi pv 011, rv 010, pd 011110, rd 001110; tibia v 0113; patella pd 8. Leg IV: tarsi pv 0110(01110); metatarsi v 011212; tibia 0222. *Abdomen*. Dorsum with dense cover of erect long dark brown bristles; venter with dense cover of weak, short, sub-erect brown bristles.

**Remarks.** This holotype specimen was earlier erroneously thought to have been collected from the Bondi State Forest (S.E. N.S.W.). It is the only example of the species presently known. It is extraordinary that more have not been collected during the long period that the Bondi urban area of Sydney

has been densely settled. Albeit this phenomenon is shared by the recently described *M. wayorum* Wishart, 2006 and is additional to the eleven known species found from the Sydney region (Wishart, 2006). The conformation of the specimen precludes it being conspecific with *M. maculosus* (Rainbow & Pulleine, 1918).

**Etymology.** The species is named in recognition of arachnologist and curator of arachnids at the Australian Museum, Graham Milledge.

**Distribution and natural history.** The spider is known only from the type locality, the Sydney seaside suburb of Bondi. That a few grains of sand are retained in the fovea of this specimen and Bondi being a sandstone locality supports the integrity of the type locality report.

## Discussion

The discovery of the spider *M. grayi* added a unique mode of burrow entrance to the variety already known within the genus. The trapdoor lid is pluglike and, when on a steeply sloped bank, opens fully out onto the lower side of the burrow entrance, the hinge being lowermost. The spider when awaiting prey rests on the open lid and thereby faces down the slope keeping the entrance open (Fig. 20I). The only other known *Misgolas* spp. which utilize a trapdoor at the burrow entrance are *M. gracilis* and *M. kirstiae* both of which have a flaccid flap as a lid. When at the entrance these spiders keep the lid open by supporting it with its caput. Table 1 gives a summary of the known forms of burrow entrances utilized by spiders of the *Misgolas* genus.

A new character introduced in this work is the presence of a pitted intrusion in the posterior wall of the fovea (e.g., Fig. 6I). Because the distribution and appearance of this character varies considerably between and within species—from well developed to absent—and can differ between sexes, its significance is uncertain. Two other characters utilized in this study have a well defined taxonomic distribution across eight of the species described here (Table 2). They are the sinuous embolus tip and distal bilateral spine clusters on metatarsi I & II. Demanding investigation also is the occurrence of the hinged lid burrow of *M. grayi*. The discovery of more such unifying characters that may relate groups of species within this large genus is needed for a better understanding of the evolutionary patterns involved.

**Table 1.** Summary of known forms of burrow entrances utilized by *Misgolas* species.

burrow entrance	<i>Misgolas</i> spp. examples
half-moon shaped flaccid lid, lid rests on caput	<i>M. gracilis</i> , <i>M. kirstiae</i>
thick plug-like lid, lid hinge lowermost, spider rests on lid	<i>M. grayi</i>
open, rigid funnel-like entrance, lip oblique, hood-like, with attached vegetation	<i>M. villosus</i> , <i>M. rapax</i>
open, aerial tube (7cm +) attached to rock or stems	<i>M. robertsi</i> , <i>M. mascordi</i>
open, lip collar-like, level with ground, sealed by folding inwards	<i>M. dereki</i>

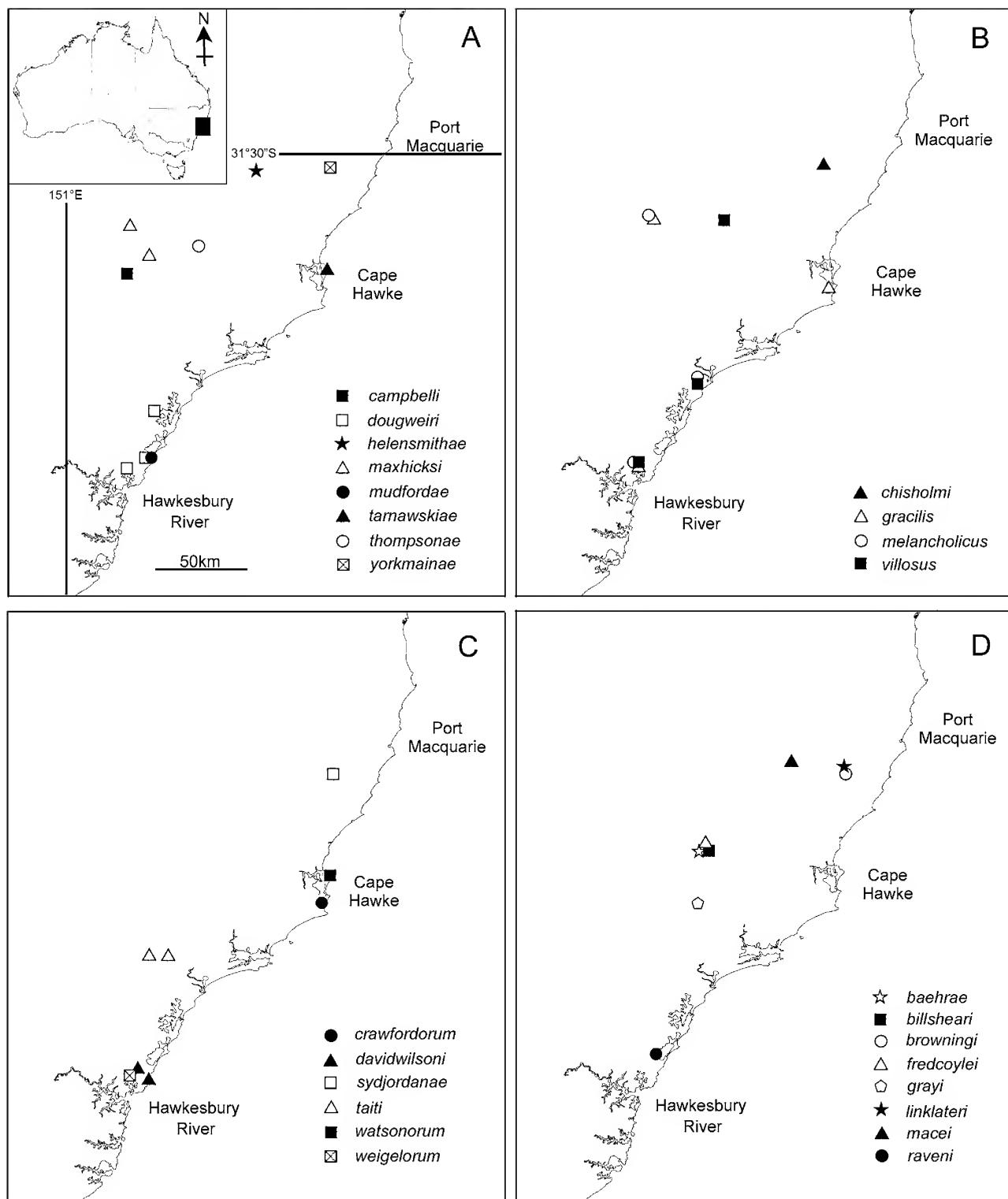


Fig. 24. A–D. Distribution of *Misgolas* species in the New South Wales Central Coast (eastern Australia) based on material examined (Inset [Fig. 24A] with catchment area).

Recent work on population genetics of slow moving invertebrates has shown that they may carry the genetic signature of past climatic events, even at a very fine scale. In Australia, this includes studies of terrestrial flatworms (Sunnucks *et al.*, 2006), collembolans (Garrick *et al.*, 2004) and funnelweb spiders (Beavis & Rowell, 2006). Moreover, comparative phylogeographic studies using multiple species make it possible to identify areas of high diversity, to inform

conservation management policy (Moritz *et al.*, 2001). As appropriate genetic markers have already been identified for use with mygalomorph spiders, the species complex identified here would be an excellent candidate for use in phylogeographic studies of this region.

**Table 2.** *Misgolas* spp. from this study with either one or both morphological characters as listed.

embolus tip sinuous	distal bilateral spine clusters on metatarsi I and II
<i>M. maxhicksi</i> n.sp.	<i>M. maxhicksi</i> n.sp.
<i>M. dougweiri</i> n.sp.	<i>M. dougweiri</i> n.sp.
<i>M. campbelli</i> n.sp.	<i>M. campbelli</i> n.sp.
<i>M. mudfordae</i> n.sp.	<i>M. mudfordae</i> n.sp.
<i>M. tarnawskiae</i> n.sp.	<i>M. yorkmainae</i> n.sp.
<i>M. thompsonae</i> n.sp.	<i>M. helensmithae</i> n.sp.

**Notes on molecular data.** Wishart and Rowell (1997) used allozymes to study relationships among a number of populations and species collected from the Sydney, Illawarra and Central Coast regions of New South Wales. On the basis of fixed gene differences and major differences in allelic frequency, it was concluded that *M. robertsi* (Main & Mascord, 1974), *M. dereki* Wishart, 1992 and *M. rapax* Karsch, 1878 (= *M. hubbardi* Wishart, 1992) represented distinct, reproductively isolated forms, supporting their assignment to different species. However the observed differences between *M. rapax* (= *M. hubbardi*) and the Berry population described in Wishart & Rowell (1997), most notably variations in venter pattern and conformation of a subdistal retrolateral apophysis on the male palpal embolus, were not reflected in allozymic variation. Thus it was argued that these two forms should not be recognized as separate species, although reservations associated with small sample sizes were expressed. By extrapolation it was also concluded that, in general, populations should be considered conspecific, despite differences in venter pattern and conformation of the subdistal retrolateral apophysis.

More recently Brownlie & Rowell sequenced 528bp of the mitochondrial cytochrome oxidase I gene for a range of spider species (unpublished), and clear differences, in the form of DNA sequence divergence, between the *M. rapax* (= *M. hubbardi*) and the Berry population have been observed. Pairwise comparisons between 2 specimens from the Berry population and 3 specimens of *M. rapax* (= *M. hubbardi*) showed sequence divergence of 10.6% to 11.4%. These are comparable with differences between recognized species such as *M. villosus* (Rainbow, 1914) from Sydney and *Misgolas* sp. Berry population (10.6%), *M. villosus* and *M. rapax* (= *M. hubbardi*) (10.2–10.8%), *M. gracilis* (Rainbow & Pulleine, 1918) and *M. rapax* (= *M. hubbardi*) (14.4–15.4%) and *M. dereki* and *M. rapax* (= *M. hubbardi*) (21–25%). Variation among the *M. rapax* (= *M. hubbardi*) and among the Berry specimens was 0.0–1.4% and 0.0% respectively.

On the basis of the magnitude of sequence divergence observed between *M. rapax* (= *M. hubbardi*) and the *Misgolas* sp. Berry population, in combination with the observed morphological differences, the recognition of these two forms as distinct species now appears justified (and will be addressed in a later publication). This is an important result as it shows that variation of venter pattern and conformation of the subdistal retrolateral apophysis on the male palpal embolus is indicative of species status in this case, despite earlier conclusions to the contrary. Given this, the taxonomic decision is taken in this work that other populations which show similar variation may represent distinct species providing justification for species status to *M. taiti* referred to by Wishart and Rowell (1997) as “Oakhampton population” and identified with *M. hubbardi* Wishart, 1992.

## Revised species status

### *Misgolas rapax* Karsch, 1878

*Misgolas rapax* Karsch, 1878: 821

#### Species in synonymy:

♂ ♀ *Misgolas hubbardi* Wishart, 1992 is placed in synonymy with *M. rapax* because female morphology of the two species does not differ significantly, this conclusion is supported by molecular data.

#### Species removed from synonymy:

♂ *Megalosara villosa* Rainbow, 1914 is removed from synonymy with *M. rapax* where it was placed by Main (1985a,b) without explanation and from which it differs in male palpal morphology. It is here recognized as *Misgolas villosus* n.comb.

♂ ♀ *Dyarcoops melancholicus* Rainbow & Pulleine, 1918 is removed from synonymy with *M. rapax* where it was placed by Main (1985a,b) without explanation and from which it differs in male palpal morphology. It is here recognized as *Misgolas melanocholicus* n.comb.

♂ ♀ *Arbanitis montanus* Rainbow & Pulleine, 1918 is removed from synonymy with *M. rapax* where it was placed by Main (1985a,b) without explanation and from which it differs in male palpal morphology. It is here recognized as *Misgolas montanus* n.comb.

♀ *Arbanitis fuscipes* Rainbow, 1914 is based on a single female and cannot therefore be unequivocally placed with one of the eleven species in the Sydney Region (Wishart, 2006). Identity uncertain.

♀ *Dyarcoops ionthus* Rainbow & Pulleine, 1918 is based on a single female and cannot therefore be unequivocally placed with one of the eleven species in the Sydney Region (Wishart, 2006). Identity uncertain.

♀ *Arbanitis chisholmi* Hickman, 1933. Morphology based on a single female, taken some distance from the known distribution of *M. rapax*, with which it was synonymized by Main (1985a,b) without explanation. Identity uncertain.

ACKNOWLEDGMENTS. Our thanks to Mr Graham Milledge for providing access to the Australian Museum spider collection; thanks also is extended to Drs Michael Gray and Helen Smith (Australian Museum) and Dr Robert Raven (Queensland Museum) for the benefit of their expertise. Dr Smith is also thanked for providing the mapping. Dr Jeremy Brownlie supplied invaluable help with DNA sequencing of some of the species described here.

## References

Beavis, A.S., & D.M. Rowell, 2006. Phylogeography of two species of funnelweb spider (*Hadronyche* sp. 1 and *Atrax* sp. 1) in Tallaganda State Forest (NSW). In: *Insect Biodiversity and Dead Wood*, Proceedings of a Symposium for the 22nd International Congress of Entomology. General Technical Report, ed. S.J. Grove and J.L. Hanula, pp. 23–29. Asheville, North Carolina: US Department of Agriculture Forest Service, Southern Research Station.  
<http://www.treesearch.fs.fed.us/pubs/24874> [18 May 2008]

Gerrick, R.C., C.J. Sands, D.M. Rowell, N.N. Tait, P. Greenslade & P. Sunnucks, 2004. Phylogeography recapitulates topography: very fine-scale local endemism of a saproxyllic giant springtail at Tallaganda in the Great Dividing Range of south-east Australia. *Molecular Ecology* 13: 3329–3344.  
<http://dx.doi.org/10.1111/j.1365-294X.2004.02340.x>

Main, B.Y., 1985a. Further studies on the systematics of ctenizid trapdoor spiders: a review of the Australian genera (Araneae: Mygalomorphae: Ctenizidae). *Australian Journal of Zoology, Supplementary Series* 108: 32–39.  
<http://dx.doi.org/10.1071/AJZS108>

Main, B.Y., 1985b. Arachnida: Mygalomorphae. In *Zoological Catalogue of Australia*, ed. D.W. Walton, pp. 1–48. Canberra: Australian Government Publishing Service.

Moritz, C., K.S. Richardson, S. Ferrier, G.B. Monteith, J. Stanisic, S.E. Williams & T. Whiffin, 2001. Biogeographical concordance and efficiency of taxon indicators for establishing conservation priority in a tropical rainforest biota. *Proceedings of the Royal Society of London, Series B-Biological Sciences* 268 (1479): 1875–1881.  
<http://dx.doi.org/10.1098/rspb.2001.1713>

Raven, R.J., & G. Wishart, 2005. The trapdoor spider *Arbanitis* L. Koch (Idiopidae: Mygalomorphae) in Australia. *Memoirs of the Queensland Museum* 51(2): 531–557.  
[http://www.qm.qld.gov.au/organisation/e\\_prints/mqm\\_51\\_2/51\\_2\\_Raven%26Wishart.pdf](http://www.qm.qld.gov.au/organisation/e_prints/mqm_51_2/51_2_Raven%26Wishart.pdf) [18 May 2008]

Sunnucks, P., M. Blacket, J.M. Taylor, C.J. Sands, S.A. Ciavaglia, N.N. Tait, D.M. Rowell & A. Pavlova, 2006. A tale of two flatties: different responses of two terrestrial flatworms to past environmental climatic fluctuations at Tallaganda in montane south-eastern Australia. *Molecular Ecology* 15: 4513–4531.  
<http://dx.doi.org/10.1111/j.1365-294X.2006.03107.x>

Wishart, G., 1992. New species of the trapdoor spider genus *Misgolas* Karsch (Mygalomorphae: Idiopidae) with a review of the tube building species. *Records of the Australian Museum* 44(3): 263–278.  
<http://dx.doi.org/10.3853/j.0067-1975.44.1992.35>

Wishart, G., 1993. The biology of spiders and phenology of wandering males in a forest remnant (Araneae: Mygalomorphae). *Memoirs of the Queensland Museum* 33(2): 675–680.

Wishart, G., 2006. Trapdoor spiders of the genus *Misgolas* (Mygalomorphae: Idiopidae) in the Sydney Region, Australia, with notes on synonymies attributed to *M. rapax*. *Records of the Australian Museum* 58(1): 1–18.  
<http://dx.doi.org/10.3853/j.0067-1975.58.2006.1446>

Wishart, G., & D.M. Rowell, 1997. Phenotypic variation in sexual and somatic morphology in the trapdoor spider *Misgolas hubbardi* Wishart in relation to its genotypic variation (Mygalomorphae: Idiopidae). *Australian Journal of Entomology* 36: 213–219.  
<http://dx.doi.org/10.1111/j.1440-6055.1997.tb01456.x>

Manuscript submitted 18 February 2007, revised 23 November 2007, and accepted 1 March 2008.

# A Reassessment of *Saltuarius swaini* (*Lacertilia: Diplodactylidae*) in Southeastern Queensland and New South Wales; Two New Taxa, Phylogeny, Biogeography and Conservation

PATRICK J. COUPER,<sup>1</sup>\* ROSS A. SADLIER,<sup>2</sup>  
GLENN M. SHEA,<sup>3</sup> AND JESSICA WORTHINGTON WILMER<sup>1</sup>

<sup>1</sup> Queensland Museum, PO Box 3300, South Bank, Brisbane Qld 4101, Australia

<sup>2</sup> Australian Museum, 6 College Street, Sydney 2010 NSW, Australia

<sup>3</sup> Faculty of Veterinary Science B01, University of Sydney 2006 NSW, Australia  
patrick.couper@qm.qld.gov.au

**ABSTRACT.** The *Saltuarius swaini* lineage comprises four species: *S. swaini* (Wells & Wellington, 1985), *S. wyberba* (Couper *et al.*, 1997), *S. moritzi* n.sp. and *S. kateae* n.sp. These are diagnosed by scalation and colour pattern differences; high levels of discrimination between these species were obtained in genetic and multivariate morphological analyses. Two species, *Saltuarius swaini* and *S. wyberba*, occur in both southeastern Queensland and northeastern N.S.W. The former is a rainforest obligate, the latter saxicolous. *Saltuarius moritzi* and *S. kateae* n.spp. are restricted to northeastern N.S.W. The former is widespread and the least specific in geological and substrate associations. The latter is restricted to the Mt Marsh area. The genus has a rainforest ancestry. Divergence within the “*S. swaini*” lineage may date to the latest Eocene–Early Miocene. We hypothesize that populations of ancestral leaf-tailed geckos would have been severely fragmented since the Mid Tertiary forcing retreat to rainforest refugia and driving allopatric speciation. Some populations shifted from trees to rocks. All four taxa are well-represented in existing reserves. *Saltuarius swaini*, a species with a continuous rainforest history and low levels of genetic variation, may be disadvantaged by ecological stasis in the face of global warming.

COUPER, PATRICK J., ROSS A. SADLIER, GLENN M. SHEA, & JESSICA WORTHINGTON WILMER, 2008. A reassessment of *Saltuarius swaini* (Lacertilia: Diplodactylidae) in southeastern Queensland and New South Wales; two new taxa, phylogeny, biogeography and conservation. *Records of the Australian Museum* 60(1): 87–118.

Leaf-tailed geckos are a distinctive, easily recognized element of the Australian fauna and one species, *Phyllurus platurus*, has occupied the homes and gardens of Sydney residents since the time of first European settlement (Bauer, 1990; Greer, 1989). Yet, until the early 1990s, the diversity within this group was largely unassessed. Aaron Bauer, in

his landmark work on the phylogenetic systematics and biogeography of the Carphodactylini (1990) recognized only four species: *P. platurus* (Shaw, in White 1790), *P. cornutus* (Ogilby, 1892), *P. caudiannulatus* (Covacevich, 1975) and *P. salebrosus* (Covacevich, 1975). These constitute less than one third of the taxa known today.

\* author for correspondence

Leaf-tails have attracted considerable interest in both taxonomic and molecular studies during the last 13 years. This, to a large degree, was sparked by the discovery of two highly distinctive, previously uncollected, taxa on the Mackay Coast in 1991 (Queensland Museum [QM], Qld National Parks and Wildlife Service) and the subsequent publication of a major revision (Couper *et al.*, 1993). A generic split was proposed; the small leaf-tails with simply-flared tails (*P. platurus* and *P. caudiannulatus*) remained in *Phyllurus* Goldfuss, 1820 while the larger leaf-tails with elaborately-flared tails (*P. cornutus* and *P. salebrosus*) were assigned to *Saltuarius* Couper, Covacevich & Moritz, 1993. The newly discovered taxa were described (*P. isis* and *P. ossa* Couper *et al.*, 1993) and two further taxa were recognized from existing museum collections: *P. nepthys* Couper *et al.*, 1993 (regarded as a population of *P. caudiannulatus* by Covacevich, 1975), and *S. occultus* Couper *et al.*, 1993 (formerly treated as a northern outlier of *P. cornutus*: Cogger, 1983, 1986, 1992; Wilson & Knowles, 1988). Additionally, *P. swaini* Wells & Wellington, 1985 was redescribed and reallocated to *Saltuarius*. This taxon encompassed the southeast Queensland (SEQ) and northern New South Wales (NSW) populations formerly treated as *S. cornutus*. Recognition of *P. swaini* was delayed because the type description was "neither complete nor accurate" (Couper *et al.*, 1993).

Ongoing fieldwork and follow-up studies combining morphological data with mitochondrial cytochrome *b* sequence data have resulted in the recognition and description of four additional taxa (*S. wyberba* Couper *et al.*, 1997; *P. championae* Schneider *et al.*, 2000 (in Couper *et al.*, 2000); *P. amnicola* Hoskin *et al.*, 2000 (in Couper *et al.*, 2000); *P. gulbaru* Hoskin *et al.*, 2003), reassignment of *S. occultus* to a new genus, *Orraya* Couper *et al.*, 2000 and the discovery of genetically divergent lineages. Couper *et al.* (1997) flagged specimens from Chaelundi State Forest, NSW (misspelt as Chelundi in that publication from incorrect donor information) as being of interest in their description of *S. wyberba* from the northern Granite Belt. This material was collected approximately 145 km SW of the *S. wyberba* type locality (Girraween National Park, SEQ) and differed at approximately 11% of sites (cytochrome *b*) from this taxon. These authors commented, "Given the level of sequence differences and the discontinuity of suitable habitat, it seems unlikely that the Chelundi and Girraween populations are conspecific. However, in the absence of comprehensive data, their status remains uncertain."

Field surveys through the northeastern forests of NSW (North-east Forest Biodiversity Study, 1991–1994; NSW National Parks and Wildlife Service, 1994) and targeted searches (1998–2004, by herpetological staff of the Australian Museum [AM] and QM) have added vastly to knowledge of the distribution of leaf-tailed geckos in SEQ and NSW, particularly through the dry forest/rock habitats and wet sclerophyll forests. This work has significantly increased museum holdings and provided fresh material for genetic analyses, and it is now appropriate to reassess the status of the species of *Saltuarius* in southeastern Australia.

## Materials and methods

The morphological components of this project utilized 167 specimens belonging to the "*S. swaini*" lineage (inclusive of *S. wyberba*) from the collections of the AM and QM. The genetic component analysed tissues from 35 specimens held by these institutions, many of which were collected specifically for this project (approved by the Australian Museum Animal Research Authority—Animal Care and Ethics Committee 17 Nov. 2004, ACEC Approval Number 04-12). Dr Chris Schneider (Boston University) kindly provided access to his unpublished sequence data and additional sequences for *S. cornutus* were downloaded from Genbank.

**Sampling strategy.** Prior to obtaining samples for genetic sampling, we mapped the distribution of the "*S. swaini*" lineage in New South Wales and southeastern Queensland, based on voucher specimens in the Australian Museum and Queensland Museum, the two major repositories of reference collections for this region. Genetic sampling attempted to obtain representation from near the type localities of the two described species, *S. swaini* and *S. wyberba*, as well as from all rainforest and extensive rock outcrop areas in the region that were known to be inhabited by *Saltuarius*, and emphasizing apparently isolated habitat blocks. We were able to genetically sample most of the known regional distribution of *Saltuarius* to within 30 km (air distance) of all confirmed localities (i.e., localities represented by historical voucher specimens in museum collections). Up to four individuals per locality were sampled. Finer-scale sampling was not undertaken for logistic reasons, and because previous studies had not recorded sympatry between leaf-tailed gecko species (30 km represents the distance between the geographically closest populations of *S. wyberba* and *S. swaini*, the two most geographically proximate species), and hence we assumed that the samples obtained adequately represented the genetic diversity and lineage representation of each locality. Only a few areas in the south of the overall distribution were not genetically sampled.

**Genetics.** Total genomic DNA was extracted from all 35 liver and tail tip tissues using a standard kit (DNeasy Tissue Kit, Qiagen). In order to discern the phylogenetic relationships of these new *S. swaini* samples, we targeted the same region of the mitochondrial cytochrome *b* gene used by Couper *et al.* (1997, 2000) to describe a new genus and additional *Saltuarius* and *Phyllurus* species. In addition to the new samples, unpublished sequence data for the same region from *S. swaini* (2), *S. wyberba* (1), *S. moritzi* n.sp. (1) [provided as *S. cf. wyberba*], *S. cornutus* (1) and *S. salebrosus* (2) individuals were provided by Chris Schneider and a further two *S. cornutus* sequences were downloaded from GenBank (see Appendix 1).

Using the primer pairs Ph-1 and MVZ04 listed in Couper *et al.* (1997), a 392bp region of the mitochondrial cyt *b* gene was amplified and sequenced, although PCR conditions and amplification parameters varied slightly from that paper. Each 25 $\mu$ l reaction contained to a final concentration 1 $\times$  Taq polymerase buffer with a final concentration of 2.5 mM MgCl<sub>2</sub>, 0.2 $\mu$ M each primer; 0.8 mM dNTPs and 0.75U of Taq polymerase. The use of the hot start polymerase HotMaster Taq (Eppendorf) required an initial

denaturation at 94°C for 2 min prior to the commencement of the remaining cycle parameters; then followed 35 cycles of 94°C for 20 sec, 45°C for 20 sec, 65°C for 30 sec and a final extension 65°C for 5 min, 22°C for 30 sec.

PCR products were gel purified and sequencing reactions carried out according to standard ABI PRISM dye-deoxy terminator sequencing protocols using Big Dye Terminator version 1.1. Sequences from the new specimens have been deposited in GenBank nucleotide sequence database (see Appendix 1) under the accession numbers EU625300–EU625342.

Chromatographs were checked and all sequences were aligned using Se-Al v2.0a10 (Rambaut, 1996). For phylogenetic analysis among all *swaini*–*wyberba* group sequences we used a Bayesian approach with posterior probabilities calculated using Markov chain, Monte Carlo (MCMC) sampling as implemented in MrBayes v 3.1 (Ronquist & Hulsenbeck, 2003). These analyses used the HKY (Hasegawa, Kishino and Yano model) +  $\Gamma$  (gamma distribution of rates) model of sequence evolution with the shape of the gamma distribution and Tratio priors set to 0.36 and 5.13 respectively, as determined by Modeltest v.3.7. Starting trees were random and 4 simultaneous Markov chains were run for 2.5 million generations with trees sampled every 100 generations. To generate the majority rule consensus tree, burnin values were set at 10 000 generations after empirical values of stabilizing likelihoods indicated that convergence of the MCMC chains had been reached. The posterior probabilities on the consensus tree are indicated only where branch support was greater than 0.5 (Posada & Crandall, 1998). Based on the previous phylogenetic studies, *S. cornutus* and *S. salebrosus* were used as outgroup sequences (Couper *et al.*, 1997, 2000).

**Morphometrics.** All measurements were taken with Mitutoyo electronic callipers and all bilateral counts were scored for the left side only. Juveniles are excluded from all measurements given as percentage SVL.

Definitions: snout to vent length (SVL), tip of snout to anterior margin of cloaca with body straightened; tail length (T), from posterior margin of cloaca to tip of tail; attenuated tip of original tail (TT), portion of tail distal to lateral flanges; head length (HL), mid anterior margin of ear to tip of snout; head width (HW), widest point across back of skull, corresponding with anterior upper margin of ear openings; head depth (HD), lower jaw to top of head, between eyes; snout length (S), anterior margin of orbit to tip of snout; eye to ear (EE) posterior margin of orbit to mid anterior margin of ear; neck length (NL) axilla to mid posterior margin of ear; length of forelimb (L1), insertion to tip of longest digit, with limb stretched straight perpendicular to body; length of hind limb (L2), insertion to tip of longest digit, with limb stretched straight perpendicular to body; axilla to groin (AG); subdigital lamellae (fourth finger, fourth toe) tip of digit to basal junction of third and fourth digits; supralabial and infralabial scale rows (from rostral and mental scales, terminating posteriorly at the angle of the mouth when the labials cease to be twice the size of adjacent granules). The hands and feet were examined for the presence or absence of enlarged dorsal tubercles and degree of spinosity on the digits. The scale rows on the snout, immediately above the anterior supralabials, were scored as: 1) grading evenly from small to large (dorsal–ventral transect), or 2) heterogeneous, small and large scales intermixed. Spines across

the attenuated tail tip were counted immediately distal to the flared portion of the original tail. The spines across the flared portion of the tail were counted three rows anteriorly to the former count. Aspects of colour/pattern were assessed (as in the descriptions that follow).

**Multivariate analyses.** We used discriminant function analysis to test the hypothesis that the four major lineages recovered from our genetic analysis were morphologically distinct. In so doing, we assumed that additional genetic lineages were not present. Discriminant function analysis was chosen rather than principal components analysis because the functions derived were capable of predicting identity of individuals of unknown identity from the few areas that were not able to be genetically sampled, and because DFA takes into account within-group covariance between characters. Thorpe (1980) found that the two techniques otherwise gave similar results in recovering known patterns of geographic variation.

Because sample sizes available for morphological study greatly exceeded those used for genetic analysis, to use only individuals of known genotype would have markedly limited sample size, particularly when sexes were analysed separately and juveniles excluded (see below), and resulted in many more unknown than known individuals. Hence, we increased the samples for morphological analyses by including individuals from within 30 km of genetically typed individuals as part of the known sample of each lineage. To reduce the risk of combining multiple genetic lineages into single morphological samples by this approach, we treated any individuals from within the overlap zone of 30 km radii of genetically distinct lineages or more than 30 km from genotyped individuals, as being of unknown identity (for allocation of specimens see Appendix 2). Because the four genetic lineages were geographically disjunct (northeast, northwest, central and south), this approach effectively tested the hypothesis that these four geographic and genetic subunits were morphologically distinguishable, and predicted the identity of unassigned individuals representing (a) regions of close geographic approach of the four geographic blocks (i.e., potential contact zones) and (b) more peripheral regions distant to genetically sampled blocks.

Preliminary morphological analyses of the three genetic species best represented (*S. swaini*, *S. wyberba* and *S. moritzi* n.sp., described herein) were undertaken to test for the existence of sexual dimorphism and allometric growth in head, body and limb proportions. All measurements were converted to natural logarithms, and the relationship between each measurement and snout-vent length (as an estimate of overall size) was calculated, for each sex of each of the three taxa.

Within at least one species for each comparison, there were significant differences in either the slope or (where slopes were not significantly different) the intercepts of the regression lines for the sexes (analysis of covariance), indicating the presence of sexual dimorphism in the relationship. Sexual dimorphism was also detected in some taxa in meristic data (t-tests).

Consequently, subsequent analyses were performed independently for each sex. Unsexed immature specimens were excluded from analyses.

Within each sex, allometry of the relationship between body, head or limb measurements and snout-vent length was

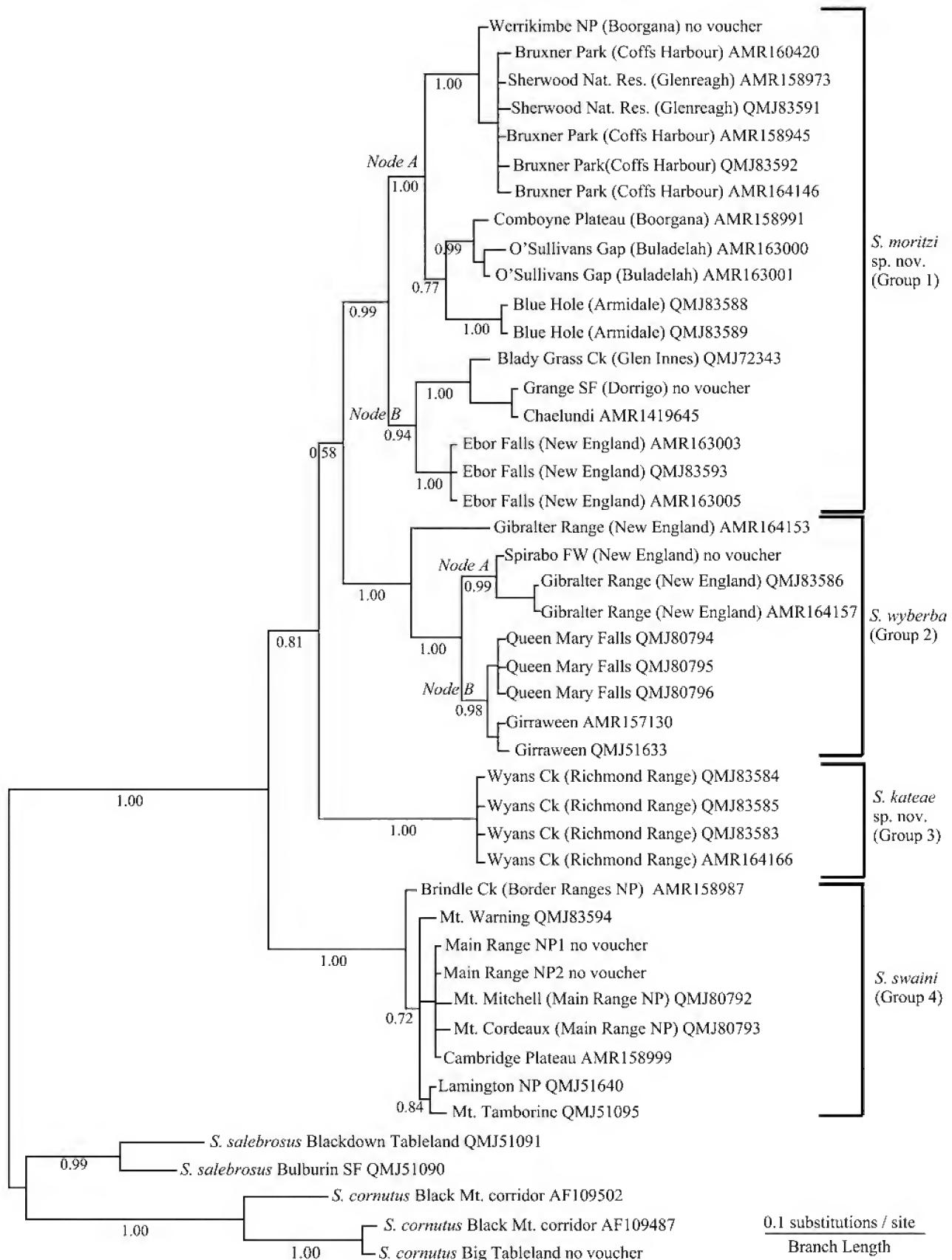


Fig. 1. Phylogeny of *Saltuarius* spp. based on cytochrome b sequence data. Some branches may be represented by multiple individuals with identical sequences. Numbers on the branches represent Bayesian Posterior Probabilities. Branches with <50% support were collapsed.

**Table 1.** Percent sequence divergence estimates within and between *Saltuarius* species groups. Values on the diagonal are the average within species estimates; values below the diagonal are the average between species estimates. Standard errors and range values (in parentheses) are presented where there are more than 2 non-identical sequences.

	<i>S. moritzi</i> n.sp.	<i>S. wyberba</i>	<i>S. swaini</i>	<i>S. kateae</i> n.sp.	<i>S. cornutus</i>	<i>S. salebrosus</i>
<i>S. moritzi</i> n.sp.	4.69±0.002 (0–8.24)					
<i>S. wyberba</i>	10.59±0.001 (8.45–11.90)	3.17±0.004 (0–7.4)				
<i>S. swaini</i>	13.01±0.001 (11.11–15.28)	14.37±0.001 (13.05–16.24)	0.73±0.001 (0–1.57)			
<i>S. kateae</i> n.sp.	11.47±0.001 (10.06–12.92)	11.34±0.001 (10.88–12.09)	14.23±0.001 (12.89–15.88)	0.00		
<i>S. cornutus</i>	22.19±0.001 (21.01–24.67)	24.52±0.002 (22.23–25.60)	22.65±0.002 (20.44–24.41)	23.10±0.007 (19.21–24.74)	6.06±0.026 (0.83–8.85)	
<i>S. salebrosus</i>	18.45±0.001 (17.15–24.67)	19.57±0.001 (18.70–21.43)	19.38±0.002 (17.96–21.15)	19.03±0.003 (17.86–20.14)	16.73±0.005 (15.77–18.92)	5.78

assessed by two methods. Firstly, allometry was considered to exist if the slope of the regression line of the variable against snout-vent length was more than two standard errors of 1.0 (Zar, 1974). However, sample sizes were small for some of the sexes and taxa, and standard errors often large, and hence for some tests, allometry was not statistically demonstrated, even though the slope of the relationship was further from isometry than for some statistically significant comparisons. Consequently, we considered there was potential for allometric growth if, for all three species studied of that sex, the slope of the regression line was uniformly in the same direction (either less than 1.0 or greater than 1.0). Using both criteria (statistical support and consistency of direction), all measurements showed some potential for allometric growth.

Hence, we used the methods of Thorpe (1975) to remove these potential effects by converting the measurements to the values they would assume for an animal of average size. For these conversions, we separately converted male and female data. For each sex, we used the average slope of the regression lines for the three well-represented species, and the mean snout-vent length of the sexed individuals. To avoid adjusting morphometric data for the effects of allometric growth runs the risk of the subsequent multivariate analyses being affected by changes in sampling distribution of body sizes (young individuals will have different shapes to older, larger adults); similarly, because our analyses combined both morphometric and meristic characters, and because allometric growth was present in the metric characters, we were unable to remove the effect of body size either by use of simple ratios or traditional principal components analyses of untransformed variables.

In our discriminant function analyses, we included those metric and meristic characters that showed significant differences between the putative genetic taxa (analyses of covariance for metric data, with snout-vent length as the independent variable; t-tests for meristic data and snout-vent length itself), and only used characters that were multi-state and variable within species. Hence, we were unable to include some categorical differences in scalation and coloration between putative taxa that were observed during our examination of specimens, even though these often differentiated the four genetic lineages. The characters we included in our multivariate analyses were: snout-vent length; adjusted

axilla–groin length; adjusted hind limb length; adjusted head length; adjusted head width; adjusted head depth; adjusted snout length; adjusted eye–ear length; adjusted neck length; number of supralabials; number of infralabials; number of finger lamellae; number of toe lamellae, and number of scales contacting the postmental.

For females, where each of the four putative taxa was represented by six or more individuals, we treated each of the four taxa as a distinct operational taxonomic unit (OTU). For males, we treated *S. swaini*, *S. wyberba* and *S. moritzi* n.sp. as identified OTUs; however because there was only a single male of *S. kateae* n.sp. (described herein), we treated this as unidentified for the analysis. The female analysis had fewer identified specimens ( $n = 40$ , representing 6 *S. kateae* n.sp., 18 *S. moritzi* n.sp., 9 *S. swaini* and 7 *S. wyberba*) than the male analysis ( $n = 74$ , representing 27 *S. moritzi* n.sp., 22 *S. swaini* and 25 *S. wyberba*).

## Results

**Genetics.** The Bayesian consensus tree (Fig. 1) clearly shows *S. swaini* (group 4) and *S. wyberba* (group 2) as very strongly supported clades with posterior probabilities of 1.00 for both groups. Clades (groups) 1 and 3 are equally robust with posterior probabilities of 0.99 and 1.00 respectively and correspond with the two new taxa identified by the morphological assessment. Species groups 1 and 2 exhibit considerable population structuring with strongly supported subgroups represented by nodes A and B in both. Average sequence divergence within each group (1–4) ranges from 0–4.69% (Table 1). The average divergence between these species groups ranges from 10.59–14.37% (Table 1). The extensive structuring within groups 1 and 2 is also represented by a wide range of within species sequence divergence estimates (Table 1). The maximum values of 8.24% and 7.40% within groups 1 and 2 respectively, while close, are still lower than the smallest interspecific divergence estimate of 8.45% (*S. moritzi* n.sp. vs *S. wyberba*).

**Morphology.** The morphological assessment identified consistent differences in colour/pattern and scalation between the four genetic lineages.

**Multivariate analyses.** Both analyses provided high levels of discrimination of the identified taxa.

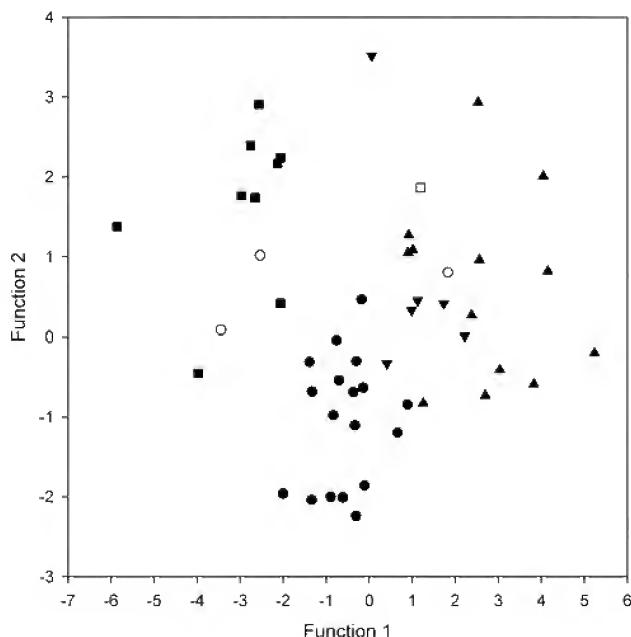


Fig. 2. Scatterplot of scores from discriminant functions 1 and 2 for female *Saltuarius*. ▼ *S. kateae* n.sp., ● *S. moritzi* n.sp., ▲ *S. swaini*, ■ *S. wyberba*. Open symbols are individuals assigned to each species on other criteria (locality, genetic identity, coloration) that were considered by the discriminant functions to belong to other species.

#### Females:

*Saltuarius kateae* n.sp. (Group 3 of the genetic analysis). All six individuals were correctly identified.

*Saltuarius moritzi* n.sp. (Group 1 of the genetic analysis). Eighteen animals were identified *a priori* as this taxon, and three individuals treated as unidentified for the analysis but tentatively expected to belong to this taxon on geographic or coloration grounds. The discriminant function analysis correctly identified 18 of the 21 individuals. The exceptions were one specimen from Giro (AM R150912), from a region not genetically studied, but closest to *S. moritzi* n.sp., which the analysis considered to be *S. swaini*; and two individuals (AM R143592, from Oakwood, treated as *S. moritzi* n.sp. due to its proximity to the Blady Grass Creek genetic sample and AM R43870 from 22 km E of Guyra, treated as unidentified for the analysis because of its distance from genetic samples, but considered to be morphologically most similar to *S. moritzi* n.sp.) which were both identified as *S. wyberba*. Hence, the analysis correctly identified 86% of *S. moritzi* n.sp.

*Saltuarius swaini* (Group 4 of the genetic analysis). Nine individuals were identified as this species and four individuals treated as unidentified. All 13 *S. swaini* were correctly identified by the analysis.

*Saltuarius wyberba*. (Group 2 of the genetic analysis). Seven individuals were identified as this species and an additional three individuals, for which precise locality data were unavailable, were expected to be this species. All of the identified *S. wyberba*, and two of the three presumed *S. wyberba*, were correctly identified (90%); the exception, one of the

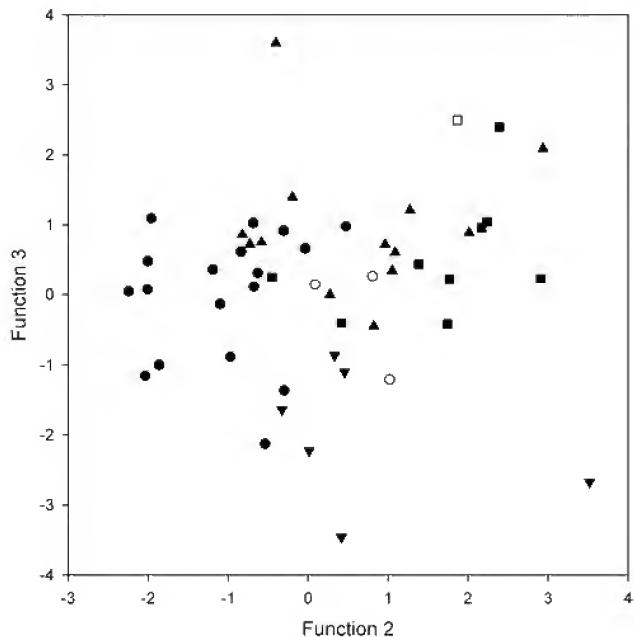


Fig. 3. Scatterplot of scores from discriminant functions 2 and 3 for female *Saltuarius*. ▼ *S. kateae* n.sp., ● *S. moritzi* n.sp., ▲ *S. swaini*, ■ *S. wyberba*. Open symbols are individuals assigned to each species on other criteria (locality, genetic identity, coloration) that were considered by the discriminant functions to belong to other species.

unlocalized specimens (QM J79753), was identified by the analysis as *S. swaini*.

Hence, of 50 females included in the analysis, the discriminant functions misidentified four individuals. If our *a priori* identifications are treated as correct, then the DFA misidentified 8% of individuals. For females, if the four misidentified individuals are excluded, the first discriminant function fully separated *S. wyberba* and *S. swaini*, with *S. kateae* n.sp. and *S. moritzi* n.sp. having intermediate values; the second function in combination with the first function fully separated *S. moritzi* n.sp. from *S. swaini* and *S. wyberba*, the third function fully separated *S. kateae* n.sp. from *S. wyberba* and *S. swaini*, and the combination of second and third functions almost completely separated *S. kateae* n.sp. and *S. moritzi* n.sp. (Figs 2–3).

The first of the three functions extracted contributed 67.3% of the total dispersion, while the first two functions contributed 84.4% of the total dispersion. Head width (negative), number of infralabials and number of supralabials, had the greatest contributions to Function 1, head width (negative), number of supralabials and number of toe lamellae had the highest contributions to Function 2, and head length (negative), head width and toe lamellae had the highest contributions to Function 3.

#### Males:

*Saltuarius moritzi* n.sp. In addition to the 27 individuals identified as this species, two additional specimens were treated as unknown. The discriminant analysis correctly identified 25 of the 27 identified individuals and the two unknowns (from the Nambucca River area, with genetic samples of this species to the north, west and south, and from "Brisbane"), an accuracy of 93%. The two incorrectly identified individu-

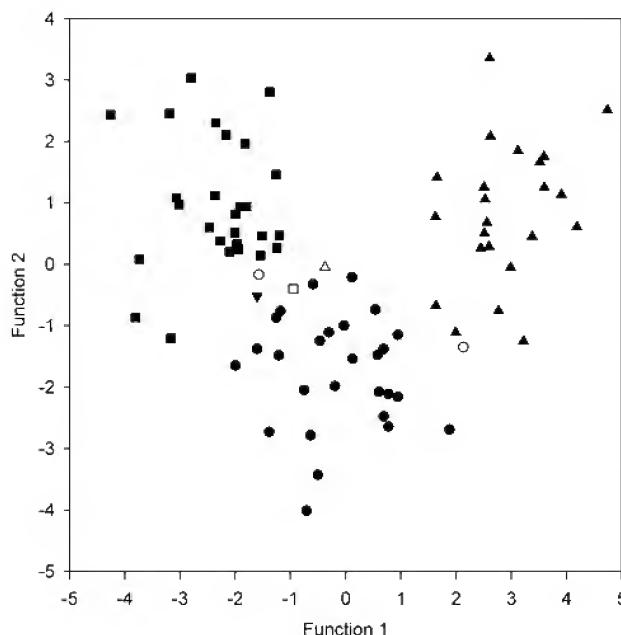


Fig. 4. Scatterplot of scores from discriminant functions 1 and 2 for male *Saltuarius*. ▼ *S. kateae* n.sp., ● *S. moritzi* n.sp., ▲ *S. swaini*, ■ *S. wyberba*. Open symbols are individuals assigned to each species on other criteria (locality, genetic identity, coloration) that were considered by the discriminant functions to belong to other species.

als were from Comboyne Plateau (AM R158990), close to a genetic sample, and geographically distant from *S. swaini*, to which it was identified by the discriminant analysis, and QM J72343, a genetically sampled individual from Blady Grass Creek, which the analysis predicted to be *S. wyberba*.

*Saltuarius swaini*. In addition to the 22 identified individuals, there were two individuals, from Mt Clunie and Mt Superbus, which although morphologically similar to *S. swaini*, were within 30 km of both *S. swaini* and *S. wyberba* genetic samples, and hence were treated as unidentified. The discriminant analysis correctly identified both of the unidentified individuals, and all but one of the identified individuals (97% accuracy). The exception was an individual from O'Reilly's (QM J51637), which the analysis considered to be *S. moritzi* n.sp.

*Saltuarius wyberba*. In addition to the 25 identified individuals, there were three specimens treated as unidentified but which we expected to be *S. wyberba* on other morphological grounds. All three, together with 24 of the 25 identified specimens, were correctly identified as *S. wyberba*. The exception was QM J83587, from Gibralter Range, which the analysis identified as *S. moritzi* n.sp.

Hence, of the 81 males considered, the discriminant analysis misidentified four individuals. If our *a priori* identifications of these four specimens are considered correct, then the DFA misidentified 5% of males. For males, if the four misidentified individuals are excluded, the first function completely separated *S. wyberba* and *S. swaini*, with *S. moritzi* n.sp. intermediate, while the combination of the first and second functions completely separated *S. moritzi* n.sp. from both *S. wyberba* and *S. swaini* (Fig. 4). The single male individual of *S. kateae* n.sp. was intermediate between *S.*

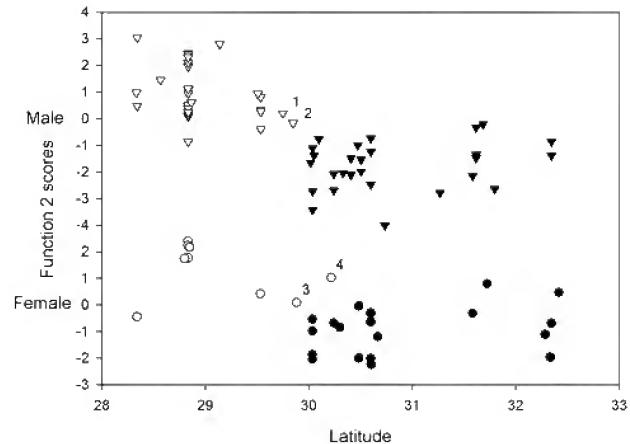


Fig. 5. Latitudinal change in discriminant function 2 scores for males (inverted triangles ▽ and ▼) and females (circles ○ and ●) for *Saltuarius wyberba* (open symbols ▽ and ○) and *S. moritzi* (closed symbols ▼ and ●). Individuals from intermediate localities are indicated by numbers: 1 = Teapot Creek; 2 = Blady Grass Creek; 3 = Oakwood State Forest; 4 = 22 km E of Guyra.

*wyberba* and *S. moritzi* n.sp., and predicted by the analysis to be *S. wyberba*.

The first of the two functions extracted contributed 72.6% of the total dispersion. Head width (negative), snout-vent length and head depth had the greatest contributions to Function 1, number of infralabials, head depth (negative), head width, snout-vent length and number of scales contacting the mental had the greatest contributions to Function 2.

### Systematics of the *Saltuarius swaini* lineage

None of the genetic lineages identified in this study show geographic overlap that would allow for assessment of species boundaries by direct application of interbreeding criteria of the traditional biological species concept. Lack of sympatry between species is typical of the entire Australian leaf-tailed gecko radiation. Instead, we adopt a phylogenetic species concept of the smallest independently evolving diagnosable unit (Cracraft, 1989), that recognizes species by the combination of genetic and morphological criteria, each of which provides evidence of independent evolution between geographically adjoining lineages. We recognize that attempts to use a standard level of sequence divergence as sole criterion for species definition must rest on a dubious assumption that speciation occurs at a relatively continuous rate and, if molecular clock hypotheses are accepted, only occurs beyond a given age. However, we consider that a high level of sequence divergence, commensurate with the level of sequence divergence between known species pairs of closely related taxa, and at a much greater degree than occurs between and within populations within related known species, can be suggestive of species-level distinction. We are encouraged to treat such lineages as full species when they are able to be distinguished morphologically, and when those

differences are maintained on geographic proximity.

Harris (2002) reported percentage differences in the *cytb* gene for congeneric gecko species of three genera (*Hemidactylus*, *Stenodactylus* and *Tarentola*) as low as 10%, and for reptiles in general a mean level of divergence between closely related species-pairs of 13.6%, while Bauer and Lamb (2001) reported interspecific differences as low as 9.7% for Namib day geckos (*Rhoptropus*) using the same gene. There have been recent suggestions that geckos in general may have higher rates of mutational change in mtDNA than other reptiles (Harris *et al.*, 2004, Jesus *et al.*, 2002, 2006), and hence that geckos should show higher levels of sequence divergence between sister-species of the same age as for other reptiles. Certainly there have been some very high levels of sequence divergence in the *cytb* gene detected between congeneric gecko species (Lamb & Bauer, 2000, 2001; Bauer *et al.*, 2002; Carranza *et al.*, 2002). However, most studies using the *cytb* gene in geckos have been based on gekkonine geckos, not diplodactyline geckos, many of the larger genetic distances have not been confirmed to be between sister-species, and the most recent study (Jesus *et al.*, 2006) was unable to exclude the possibility that the comparative nuclear gene they used was not evolving unusually slowly. The only comparable study using *cytb* for diplodactyline geckos is by Couper *et al.* (2000), who reported sequence divergences between other *Saltuarius* and *Phyllurus* species as low as 12.3%.

We begin our assessment of species boundaries in the *Saltuarius swaini* complex by considering the two named species, *S. swaini* (group 4) and *S. wyberba* (group 2). These two taxa approach geographically to within 15 km (Mt Clunie and Mt Superbus *vs* Queen Mary Falls). Samples of the two 30 km apart have been genetically typed (4 *swaini* from Main Range National Park; 3 *wyberba* from Queen Mary Falls) and each sample is genetically homogeneous and nested deeply within its respective species. The two species show 14.37% sequence divergence, comparable to other leaf-tail gecko species pairs. Morphologically, the two species are distinguishable on coloration, size and snout scalation (see direct comparisons below) and are distinguishable in morphological space in multivariate analyses, and these differences are maintained in geographic proximity. Multivariate analyses consistently assigned identity to individuals from localities of closest approach that agreed with the expectations of coloration. Hence, we have no hesitation in continuing to recognize these two species as distinct. *Saltuarius swaini* maintains its genetic and morphological integrity over a latitudinal distance of 102 km while *S. wyberba* similarly maintains its integrity over a latitudinal range of at least 133 km.

The Group 3 lineage, geographically to the south of *S. swaini*, is separated from it by 38 km (Wyans Creek *vs* Cambridge Plateau, type locality for *S. swaini*). At this closest known approach, the genetic and morphological distinction between the two is maintained, and they differ by 14.23% genetic distance, a level very close to that between *S. swaini* and *S. wyberba*. Group 3 is geographically more widely disjunct from *S. wyberba* (60 km from Wyans Creek to Gibralter Range, the closest genetic sampling, and 47 km from Wyans Creek to Timbarra Plateau, the closest individual morphologically), and apparently isolated from it by the Clarence River valley. The genetic distance between Group 3 and *S. wyberba* is 11.34%, and the two lineages are morphologically distinguishable in scalation, head width (see

comparisons below) and in morphological multivariate space (no individuals of *S. wyberba* and Group 3 were misidentified as each other in either the female or male analyses). Hence, we recognize Group 3 as a species distinct from *S. swaini* and *S. wyberba*, and describe it below as *S. kateae* n.sp.

The remaining lineage, Group 1, represents all southern populations of the *S. swaini* complex, and covers a latitudinal range of at least 271 km. It is genetically divergent from *S. swaini* by 13.01%, geographically widely disjunct from it (137 km between Cambridge Plateau *vs* Chaelundi, and 75 km if the Grange State Forest locality is accepted; see below), with the Clarence River valley forming a geographic barrier to dispersal, and maintains its morphological and genetic distinction at these closest approaches. It is distinguishable from *S. swaini* by coloration, body size and snout scalation (see below). Multivariate analyses misidentified only one of 34 females and two of 53 males as the other species; none of the three misidentified individuals were from near regions of closest geographic approach and all were unambiguously referable to the correct lineage on other morphological grounds. Group 1 is similarly genetically distinct from *S. kateae* n.sp. by 11.47% sequence divergence, geographically widely disjunct from it (101 km between nearest genetic samples from Wyans Creek, and Chaelundi; 45 km if the Grange State Forest locality is accepted), again with the Clarence River valley forming a barrier to contact, and morphologically distinct at this nearest approach, both in multivariate morphological space and in scalation and coloration. No females of either lineage were identified as the other lineage by discriminant function analysis, while the single male *S. kateae* n.sp. was predicted to be Group 1 because it was morphologically closest to that lineage, not because it fell within the morphological space of that group.

Hence, we consider Group 1 to warrant specific distinction from both *S. swaini* and *S. kateae* n.sp. The nature of the interaction between Group 1 and *S. wyberba*, to which it is closest genetically and geographically, warrants further consideration. These two genetic lineages have the lowest level of sequence divergence (10.59%) in the *S. swaini* complex, a divergence near the lower level for sister-species of other geckos (Harris, 2002; Bauer & Lamb, 2001). The extent of sequence divergence within each group is considerably lower (an average of 4.69% for Group 1, over a latitudinal range of 271 km, and 3.17% for *S. wyberba*, over a 133 km latitudinal range), less than half the divergence between the two lineages, and there is a moderate degree of morphological distinction between the two. Multivariate analyses distinguished 47 of 50 (94.0%) Group 3 specimens from 37 of 38 (97.4%) *S. wyberba*. However, the four individuals that proved problematic to the multivariate analyses were from localities either representing the most proximate samples of otherwise unequivocal *S. wyberba* to Group 1 (one of five individuals from Gibralter Range identified as Group 1), or from a small area (53 km from north to south) to the south and geographically intermediate between *S. wyberba* at Gibralter Range and Group 1 at Ebor Falls and Chaelundi, raising the possibility of a zone of intermediacy or hybridization between the two putative taxa.

Only four individuals were able to be examined from this intermediate region: J53984 from Teapot Creek; J72343 from Blady Grass Creek; R43870 from 22 miles E of Guyra, and R143592 from Oakwood State Forest. The multivariate analyses identified all four individuals as *S. wyberba*, while

the only one that was able to be genetically examined (J72343) had the *cytb* profile of Group 1. Function 2 of both male and female discriminant function analyses most strongly differentiated these two lineages. A plot of function 2 scores against latitude (Fig. 5) shows little evidence for clinal change; the four specimens from intermediate localities are well within the range of variation of *S. wyberba* and the two lineages show only weak geographic variation across their distribution.

As both genetic and morphological analyses distinguish northern and southern groups, and the morphological distinction between these groups is not clinal, and the genetic differentiation between the two groups is much greater than between populations within the other species of the *S. swaini* complex, we believe that group 1 warrants taxonomic recognition as distinct from *S. wyberba*.

Sampling is as yet insufficient to resolve the discrepancy between genetic and morphological assignment of individuals from a small intermediate zone, and hence we treat this population as *incertae sedis*. As the magnitude of the genetic and morphological differentiation between Group 1 and *S. wyberba* is only a little less than between other pairs of species, we treat Group 1 as a distinct species, which we describe below as *S. moritzi* n.sp. However, we recognize that further work is needed to clarify the exact nature of the interaction between *S. moritzi* n.sp. and *S. wyberba* at closest approach, and it is possible that a subspecific distinction may ultimately best label the interaction.

The two new species are described in the systematics section that follows. *Saltuarius swaini* sensu stricto and *S. wyberba* are redescribed. The former species was composite,

**Table 2.** Comparison of body proportions (as % SVL) between members of the “*S. swaini*” lineage.

Measurement	<i>S. moritzi</i> n.sp.	<i>S. swaini</i>	<i>S. kateae</i> n.sp.	<i>S. wyberba</i>
Adult body length				
max SVL (mm)	109.3	134.0	105.4	107.7
N	62	46	7	41
Tail length % SVL				
range	63.0–76.0	59.2–72.4	not available	62.3–80.7
mean±sd	68.9±3.53	66.9±4.11		71.2±4.32
N	17	16		14
Attenuated tail % SVL				
range	23.9–31.6	24.4–33.6	not available	20.7–36.8
mean±sd	27.9±2.19	27.4±2.85		29.0±4.07
N	17	16		14
Head length % SVL				
range	25.4–29.8	25.2–28.5	26.5–27.7	24.7–29.3
mean±sd	26.9±0.83	26.2±0.64	27.2±0.48	27.3±0.97
N	49	40	7	36
Head width % SVL				
range	19.9–24.2	18.7–22.0	20.8–22.0	19.8–23.9
mean±sd	21.2±0.78	20.4±0.80	21.3±0.47	22.1±0.95
N	49	40	7	36
Snout length % SVL				
range	11.4–14.1	10.1–13.5	11.8–12.5	11.0–13.7
mean±sd	12.2±0.49	12.2±0.48	12.2±0.22	12.1±0.49
N	49	40	7	36
Eye-ear % SVL				
range	7.4–10.3	7.4–9.4	7.5–9.2	7.5–10.0
mean±sd	8.5±0.61	8.3±0.46	8.3±0.66	8.9±0.63
N	49	40	7	36
Neck length % SVL				
range	15.8–23.0	14.5–22.4	15.0–19.7	15.1–21.3
mean±sd	19.4±1.48	18.6±1.73	17.4±1.52	17.7±1.46
N	49	40	7	35
Axilla-groin % SVL				
range	39.9–50.1	41.3–51.3	44.6–48.0	39.9–48.3
mean±sd	45.1±2.12	46.2±2.30	46.8±1.27	45.0±1.91
N	49	39	7	36
Forelimb % SVL				
range	41.5–51.6	44.0–51.1	44.9–47.4	44.0–50.9
mean±sd	47.4±2.26	48.2±1.60	46.3±0.96	47.2±1.92
N	49	36	7	35
Hind limb % SVL				
range	52.0–62.4	53.2–62.3	55.4–60.4	53.1–63.3
mean±sd	57.7±2.24	58.7±2.24	58.0±2.00	57.4±2.50
N	49	36	7	34

incorporating specimens of *S. moritzi* n.sp. in the latest formal description (Couper *et al.*, 1993); the latter species exhibits colour/pattern and scalation variations that were not encompassed in the type description (Couper *et al.*, 1997).

The two new taxa, along with *S. wyberba*, are sibling species to *S. swaini* (see phylogeny, Fig. 1). They are assignable to *Saltuarius* by the following characters: nostril contacting the rostral (except in *S. kateae* n.sp.); rostral completely divided; moderate to large size (max SVL 105–134 mm); original tail strongly flared with an elaborate outer flange (not yet assessable for *S. kateae* n.sp.); regenerated

tail strongly flared, with only a small attenuated tip. Skeletal features were not assessed, but given the uniformity of these across the genus, they are unlikely to vary from the generic description (Couper *et al.*, 1993). The skeletons of *S. swaini* and *S. wyberba* show no significant differences (Couper *et al.*, 1993, 1997). The “*S. swaini*” lineage is morphologically distinguished from its northern congeners by the absence of preanal pores in both sexes (present in males in the northern taxa). Morphometric summaries for the species comprising the “*S. swaini*” lineage are provided in Tables 2 & 3.

**Table 3.** Comparison of key scalation characters between members of the “*S. swaini*” lineage.

Scale count	<i>S. moritzi</i> n.sp.	<i>S. swaini</i>	<i>S. kateae</i> n.sp.	<i>S. wyberba</i>
Scales contacting posterior margin of mental				
range	1–7	3–8	4–7	4–11
mode	4	6	4	6
mean±sd	4.9±1.15	5.4±1.14	5.0±1.29	6.0±1.42
N	61	45	7	40
Supralabials				
range	10–18	12–18	13–16	11–18
mode	13	14	14	14
mean±sd	13.5±1.35	14.9±1.53	14.4±0.98	14.5±1.43
N	61	46	7	41
Infralabials				
range	9–14	9–16	12–13	10–15
mode	12	12	12	12
mean±sd	11.9±1.20	12.8±1.45	12.1±0.38	12.3±1.10
N	62	46	7	41
Lamellae (4th finger)				
range	17–23	18–26	19–22	16–24
mode	19	22	21	18
mean±sd	19.6±1.43	21.5±1.64	20.4±1.13	19.2±1.61
N	60	46	7	41
Lamellae (4th toe)				
range	19–26	20–28	21–24	19–25
mode	24	23	24	20
mean±sd	22.6±1.75	24.0±1.71	23.3±1.11	21.6±1.66
N	62	46	7	41
Tail tubercles (across flared portion)				
range	4–7	6–13	Not available	4–8
mode	6	10		6
mean±sd	5.4±0.89	9.4±1.74		5.6±1.21
N	27	19		14
Tail tubercles (across attenuated tip)				
range	4–6	5–10	Not available	4–7
mode	4	6		6
mean±sd	4.3±0.60	6.4±1.16		5.4±0.94
N	26	19		14

### *Saltuarius kateae* n.sp.

Fig. 6

**Material examined.** HOLOTYPE, AM R164163, Wyans Creek Road, 11.4 km W of Old Tenterfield Road (29°08'31"S 152°47'06"E) NSW. R. Sadlier, G. Shea & P. Couper. PARATYPES: QM J83583–85, AM R164161, AM R164166, collection data as for holotype. AM R139790 Mount Marsh SF (29°12'52"S 152°49'17"E) NSW.

**Etymology.** For Kate Couper for her ongoing support during the field component of this project.

**Diagnosis.** A medium-sized *Saltuarius* (maximum SVL 105 mm) with smooth throat scales, no preanal pores (in either sex) and an obscure, narrow V-shaped marking running back deeply between the eyes (Fig. 7A). It is distinguished from its congeners by the following combination of character states: rostral shield usually excluded from nostril (Fig. 8A); scales on snout usually grade evenly from small to large (in dorsal–ventral transect, Fig. 9A); dorsal surface of hand free of large conical tubercles; digits without spinose tubercles along dorsal surface (Fig. 10A); body darkly pigmented, reducing extent of dorsal cross-bands between fore and hind limbs (Fig. 6).

### Description

SVL (mm): 84.5–105.4 (n = 7, mean = 98.5, SD = 6.61). Proportions as % SVL: T unknown (no original tails in sample); HL = 26.5–27.7 (n = 7, mean = 27.2, SD = 0.48); HW = 20.8–22.0 (n = 7, mean = 21.3, SD = 0.47); S = 11.8–12.5 (n = 7, mean = 12.2, SD = 0.22); EE = 7.5–9.2 (n = 7; mean = 8.3, SD = 0.66); NL = 15.0–19.7 (n = 7, mean = 17.4, SD = 1.52); AG = 44.6–48.0 (n = 7, mean = 46.8, SD = 1.27); L1 = 44.9–47.4 (n = 7, mean = 46.3, SD = 0.96); L2 = 55.4–60.4 (n = 7, mean = 58.0, SD = 2.00).

**Head.** Large, depressed, triangular, distinct from neck; head depth 39.1–44.3% head width (n = 7, mean = 41.7, SD = 1.71); covered in small granules which are intermixed with larger conical tubercles; skin of head co-ossified with skull; rostral shield fully divided by deep vertical groove (n = 7); rostral shield excluded from nostril (Fig. 8A; except on left side of QM J83585); scales contacting posterior margin of mental shield 4–7 (n = 7, mode = 4, mean = 5.0, SD = 1.29); ear opening elliptical, vertical, much less than half as large as eye; supralabials 13–16 (n = 7, mean = 14.4, mode = 14, SD = 0.98); scales on snout usually grade evenly from small to large (in dorsal–ventral transect, Fig. 9A); infralabials 12–13 (n = 7, mode = 12, mean = 12.1, SD = 0.38). **Neck.** Broad. **Body.** Moderate, depressed, covered in small granules; dorsal granules intermixed with larger conical tubercles; tubercles small to moderate on back, flanks and sides of neck; basal scales surrounding upper flank and back tubercles not, or only slightly, larger than adjacent granules; ventral scales enlarged in pelvic region. Preanal pores absent. Axilla moderately to deeply invaginated. **Limbs.** Long, covered in small pointed tubercles dorsally; lacking enlarged tubercles on ventral surfaces; digits strongly compressed distally; subdigital lamellae (fourth finger) 19–22 (n = 7, mode = 21, mean = 20.4, SD = 1.13); dorsal surface of hand free of large

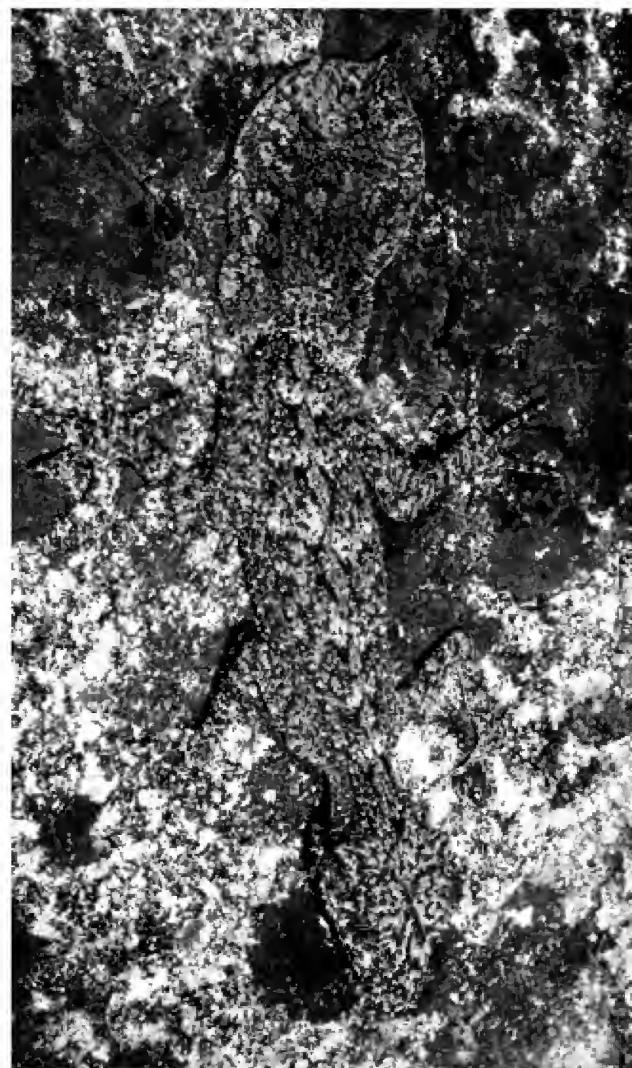


Fig. 6. *Saltuarius kateae* n.sp. (AM R164163—holotype), Wyans Creek Road, 11.4 km W of Old Tenterfield Road (29°08'31"S 152°47'06"E) NSW (photograph—R. Sadlier, AM).

conical tubercles; dorsal surface of fingers without enlarged, spinose scales; subdigital lamellae (fourth toe) 21–24 (n = 7, mode = 24, mean = 23.3, SD = 1.11); dorsal surface of foot with enlarged conical tubercles centred mainly above 4th and 5th digits; dorsal surface of toes without enlarged spinose tubercles (Fig. 10A). **Original tail,** unknown. **Regenerated tail** approximately 52% SVL when fully regenerated; depressed, broad and strongly leaf-like, contracted at base with short attenuated tip; slight tapering and folding of lateral flange anteriorly; covered with uniform granules and minute, spinose lateral tubercles.

**Colour pattern** In spirit, head body and limbs finely marbled with grey and mid to dark brown blotches; a narrow brown vertebral stripe (edged with dark brown), broken by 6–7 obscure (brown or greyish) cross-bands between fore and hind limbs. Some individuals are more heavily pigmented, and hence, much darker in overall appearance. Head with an obscure, deep V-shaped marking between eyes (Fig. 7A) and obscure, ragged cross-bands on snout; labials pale, but broken by dark brown blotches. Limbs with obscure, broken bands; digits clearly banded with dark brown and grey.

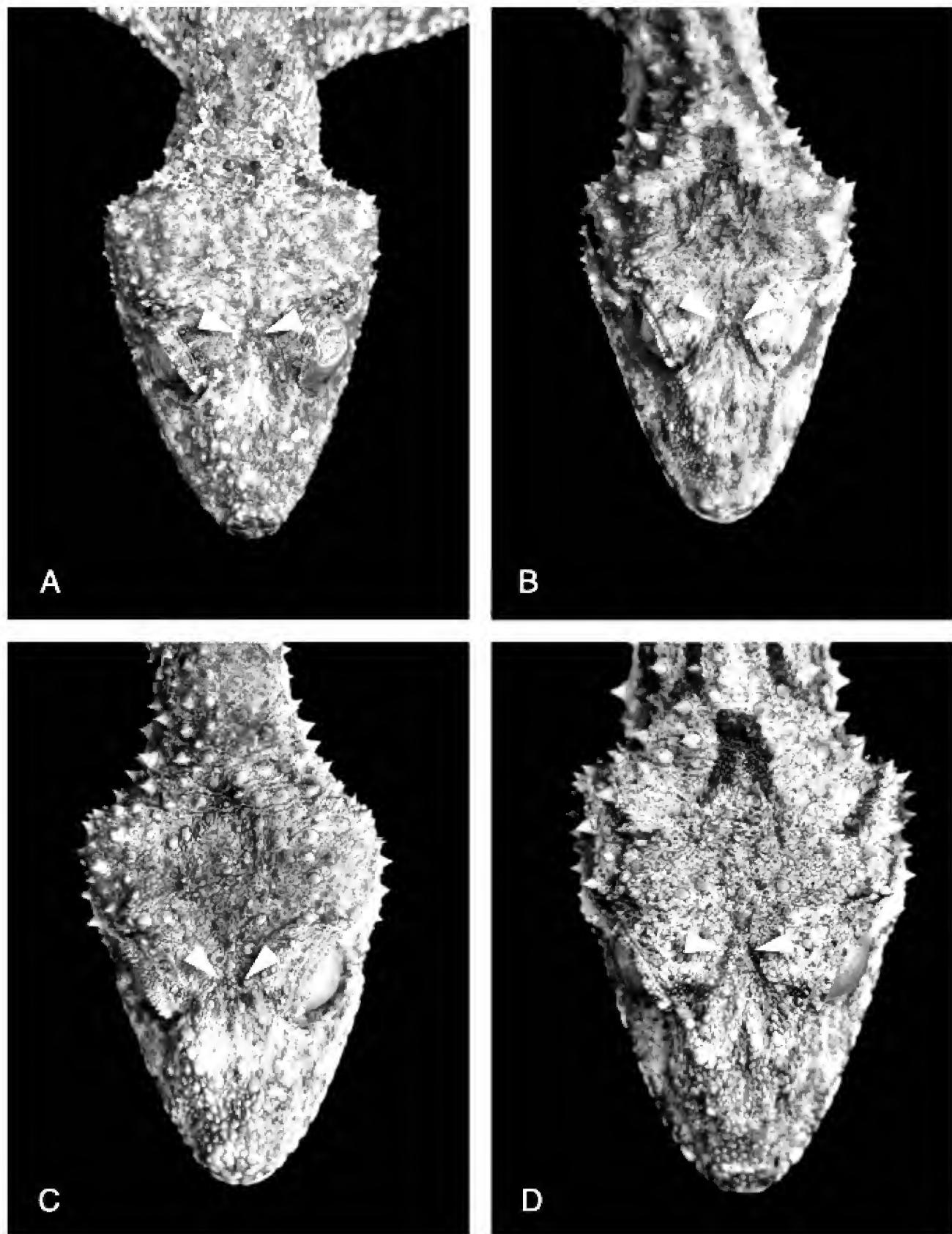


Fig. 7. V-shaped pattern between eyes in (A) *Saltuarius kateae* n.sp. AM R164166; (B) *S. moritzi* n.sp. AM R160420; (C) *S. moritzi* n.sp. AM R158990; (D) *S. swaini* QM J51640; (E, facing page) *S. wyberba* QM J28648.

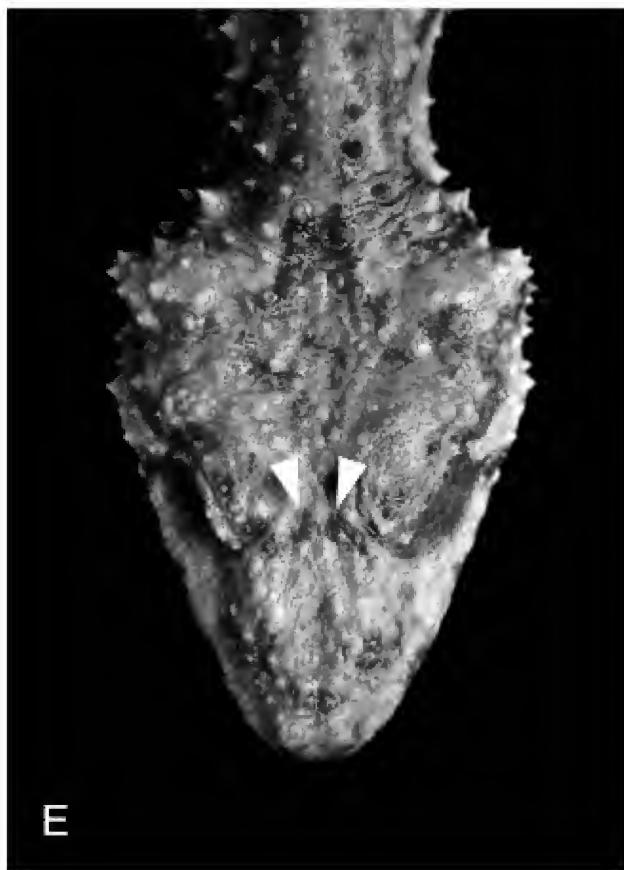


Fig. 7 (continued). V-shaped pattern between eyes in *S. wyberba* QM J28648.

Venter cream to pale grey, heavily peppered with brown. Regenerated tail greyish with heavy mottling (mid to dark brown) above; ventral surface similar, but with reduced pigmentation.

**Measurements and scale counts of holotype.** AM R164163 (female) SVL = 100.3 mm, T(regrown) = 52.4 mm, HL = 26.9 mm, HW = 21.1 mm, HD = 8.6 mm, S = 12.3 mm, EE = 8.4 mm, NL = 19.8 mm, L1 = 45.0 mm, L2 = 56.3 mm, AG = 47.0 mm, Lamellae 4th finger 20, Lamellae 4th toe 24, supralabials 15, infralabials 12, scales contacting posterior edge of mental 4.

**Genetics.** *Saltuarius kateae* n.sp. differs in cytochrome *b* sequences from other members of the “*S. swaini*” lineage at 11.34–14.23% of sites (Table 1). It differs from its northern congeners *S. cornutus* and *S. salebrosus* at 23.10% and 19.03% of sites respectively. No intraspecific sequence divergence was recorded within the Wyans Creek sample.

**Distribution.** Narrowly restricted between latitudes 29°08'S and 29°13'S in northern NSW. The two known collection sites (Wyans Creek Road and Mt Marsh) lie on the eastern side of the Clarence River at the extreme southern end of the Richmond Range and are approximately 10 km apart (Fig. 11).

**Geology.** The distribution of *S. kateae* n.sp. is restricted to the southern portion of the Clarence-Moreton Basin on

continental sandstone (Kangaroo Creek Sandstones) of Cretaceous–Jurassic age.

**Habitat.** Associated with sandstone escarpments in open forest (blackbutt/bloodwood) communities.

**Comparison with other species.** *Saltuarius kateae* n.sp. is readily distinguished from *S. cornutus* and *S. salebrosus* in lacking preanal pores in both sexes (vs present in males). It is further separated from *S. cornutus* by its lower flank tubercles which are not hooked and lack smaller basal spines (vs tubercles hooked and surrounded by smaller spines) and from *S. salebrosus* by having a smooth throat (vs throat strongly tuberculate). It is most similar to *S. moritzi* n.sp., *S. swaini* and *S. wyberba*. From these it is separated by the rostral / nostril contact (rostral usually excluded from nostril (Fig. 8A) vs rostral and nostril usually in contact (Fig. 8B), rarely excluded) and the absence of spinose tubercles from the dorsal surface of all digits (Fig. 10A; vs spinose tubercles rarely absent from all digits, Fig. 10B). It is further distinguished from *S. swaini* by max SVL (105.4 mm vs 134.0 mm), from *S. moritzi* n.sp. by its darker pigmentation (and associated reduction in the extent of dorsal cross-bands between fore and hind limbs) and from *S. wyberba* by its greater head depth (39–44% head width, n = 7, mean = 41.7, SD = 1.71 vs 36–42% head width, n = 35, mean = 39.3, SD = 1.65).

**Remarks.** The Clarence River isolates *S. kateae* n.sp. from populations of *S. moritzi* n.sp. to the south and *S. wyberba* to the west. Like *S. kateae* n.sp., *S. swaini* occurs in the Richmond Range, to the east of the Clarence River. However, there is clear habitat separation between the two species.

### *Saltuarius moritzi* n.sp.

Figs 12A–C

**Material examined.** HOLOTYPE, AM R158990 Comboyne Plateau, Boorgana NR (31°36'56"S 152°24'53"E) NSW. PARATYPES: QM J56894 Evans Rd, Salisbury, Brisbane (found on warehouse wall; said to have arrived in truck-load of ferns from NSW); AM R141964 Chaelundi SF (30°01'07"S 152°30'02"E) NSW; QM J83590–91, AM R158973–74, AM R158977–78, AM R160421 Sherwood NR, near Glenreagh (30°02'10"S 153°00'26"E) NSW; AM R141965 Chaelundi SF, Sundew Lookout (30°03'04"S 152°21'36"E) NSW; AM R153478 Sherwood NR, ridgeline N of Ewens Gap (30°05'52"S 153°01'12"E) NSW; AM R123490 Tallawudjah Ck (30°08'S 152°58"E) NSW; AM R158945–46, QM J83592, AM R160420 Bruxner Park, near Coffs Harbour (30°14'30"S 153°05'36"E) NSW; AM R164146 Coffs Harbour area, 1.9 km towards lookout from intersection of Bruxner Park Rd (30°15'54"S 153°06'41"E) NSW; AM R69866–67, AM R81921, Coffs Harbour (30°18'S 153°08'E) NSW; AM R43875 Dorrigo (30°20'S 152°43"E) NSW; QM J83593, AM R163003, AM R163005 Ebor Falls (30°24'19"S 152°20'20"E) NSW; AM R54071, AM R106749, AM R97670–72 Bellinger River N arm, near Brinerville (30°28'20"S 152°32'37"E) NSW; AM R16905, AM R16989, AM R17008 New England NP, Point Lookout, near Armidale (30°29'S 152°25'E) NSW; AM R43871–73 New England NP, at Point Lookout (30°30'18"S

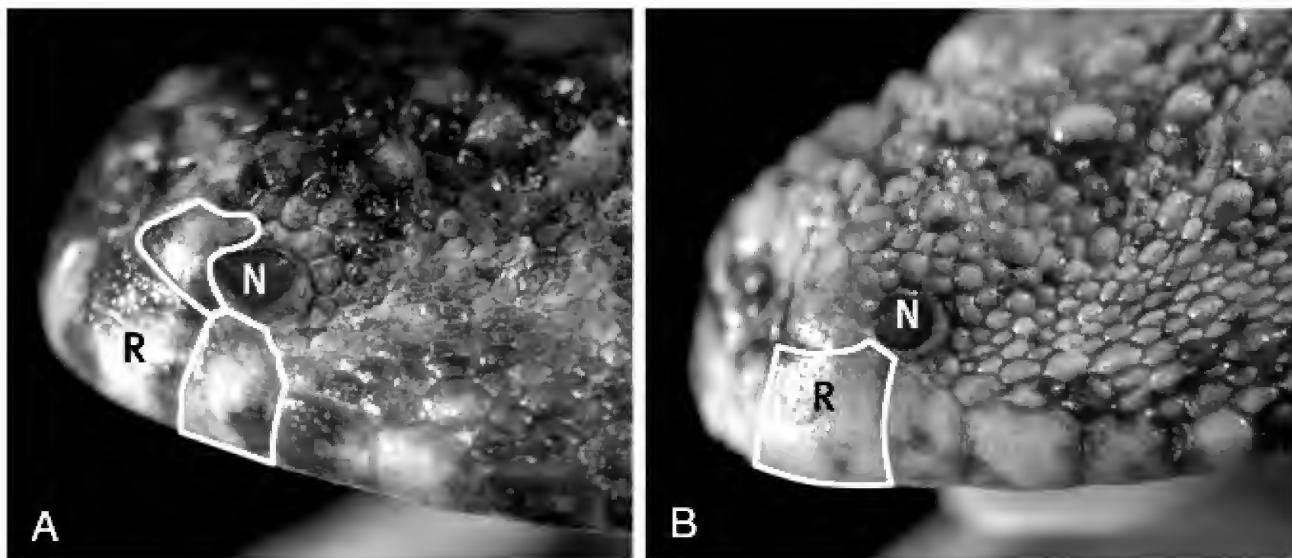


Fig. 8. (A) Rostral scale excluded from nostril, *Saltuarius kateae* n.sp. QM J83583; (B) rostral scale contacts nostril, *S. swaini* QM J51637. Condition (B) also applies for *S. moritzi* n.sp. and *S. wyberba*.

152°23'00"E) NSW; QM J83588–89, AM R163006, AM R163009–10, AM R163012 Blue Hole, SE Armidale on upper reaches of Gara River (30°36'00"S 151°48'09"E) NSW; AM R143590 Gara River—first falls downstream of Blue Hole (30°36'03"S 151°48'13"E) NSW; AM R6792 Purgatory Creek, Taylors Arm, Nambucca River (30°40'0"S 152°57'E) NSW; AM R6284 Gurravembi, Nambucca River, near Macksville (30°44'S 152°59'E) NSW; AM R103031 Wonders Hill Homestead, 4.5 km N (31°16'S 152°19'E) NSW; AM R71372–73 Lorne SF, Comboyne Peak (31°35'S 152°33'E) NSW; AM R6247 Bulga Tableland, near Bobin, Manning River (31°37'S 152°15'E) NSW; AM R6915 Bulgong, near Wingham (31°37'S 152°18'E) NSW; AM R151753 Kerewong State Forest, 300 m upslope McLeods Ck crossing, McLeods Creek Rd (31°38'10"S 152°32'44"E) NSW; AM R59314 5 km W of Hwy on Middle Brother Mtn (31°41'S 152°42'E) NSW; AM R59313 Middle Brother SF, Bird Tree area (31°41'S 152°42'E) NSW; AM R43874 Lansdowne, Manning River (31°47'39"S 152°32'00"E) NSW; AM R8253 Wallis Lake, Tuncurry (32°17'S 152°29'E) NSW; AM R101338 O'Sullivan's Gap Forestry Reserve, NE of Bulahdelah (32°20'S 152°16'E) NSW; AM R163000–02 O'Sullivan's Gap, c. 10 km N Bulahdelah on Old Pacific Hwy (32°20'38"S 152°15'35"E) NSW; QM J9054 Bulahdelah, 96 km NE Newcastle (32°25'S 152°12'E) NSW; AM R15412 Girvan via Stroud (32°29'S 152°02'E) NSW; AM R143591 Nerong SF, Nerong Rd, 1.2 km N from Boundary Rd (32°31'38"S 152°09'12"E) NSW.

**Additional material examined.** AM R141966 Grange SF (29°27'03"S 152°23'06"E) NSW; AM R150911–12 Giro SF, Mountain Creek Trail, Qbx Rd (31°43'23"S 151°52'26"E) NSW.

**Etymology.** For Professor Craig Moritz (University of California at Berkeley) for his contributions to the molecular phylogenetics of Australian rainforest reptiles.

**Diagnosis.** A medium-sized *Saltuarius* (maximum SVL 109 mm) with smooth throat scales, no preanal pores (in either sex) and often with a prominent, narrow V-shaped marking

running back between the eyes (Fig. 7B). It is distinguished from its congeners by the following suite of characters: rostral shield usually contacts nostril (Fig. 8B); dorsal surface of toes usually with large spinose tubercles (Fig. 10B); scales on snout usually grade evenly from small to large (in dorsal–ventral transect, Fig. 9A), not intermixed with larger granules above the supralabials (Fig. 9B); two narrow pale bands are usually continuous across the flared portion of the original tail (Fig. 13A); enlarged dorsal and lateral tubercles do not extend to tail tip (Fig. 13A); dark markings on head generally not strongly contrasting with base colour.

## Description

SVL (mm): 38.3–109.3 (n = 62, mean = 85.5, SD = 20.20). Proportions as % SVL: T = 63.0–76.0 (n = 17, mean = 68.9, SD = 3.53); TT = 23.9–31.6 (n = 17, mean = 27.9, SD = 2.19); HL = 25.4–29.8 (n = 49, mean = 26.9, SD = 0.83); HW = 19.9–24.2 (n = 49, mean = 21.2, SD = 0.78); S = 11.4–14.1 (n = 49, mean = 12.2, SD = 0.49); EE = 7.4–10.3 (n = 49, mean = 8.5, SD = 0.61); NL = 15.8–23.0 (n = 49, mean = 19.4, SD = 1.48); AG = 39.9–50.1 (n = 49, mean = 45.1, SD = 2.12); L1 = 41.5–51.6 (n = 49, mean = 47.4, SD = 2.26); L2 = 52.0–62.4 (n = 49, mean = 57.7, SD = 2.24). **Head.** Large, depressed, triangular, distinct from neck; head depth 37.3–49.1% head width (n = 62, mean = 42.4, SD = 2.66); covered in small granules which are intermixed with larger conical tubercles; skin of head co-ossified with skull; rostral shield fully divided by deep, vertical groove (n = 57), not divided (n = 1), only half divided (n = 2) or divided into three (n = 1); rostral shield contacting nostril (n = 58), narrowly excluded from nostril (n = 1) or narrowly excluded from nostril on one side only (n = 3); scales contacting posterior margin of mental shield 1–7 (n = 61, mode = 4, mean = 4.9, SD = 1.15); ear opening elliptical, vertical, much less than half as large as eye; supralabials 10–18 (n = 61, mode = 13, mean = 13.5, SD = 1.35); scales on snout usually grade evenly from small to large (in dorsal–ventral transect, Fig. 9A), not intermixed with larger granules above the supralabials (Fig. 9B); infralabials 9–14 (n = 62, mode = 12, mean =

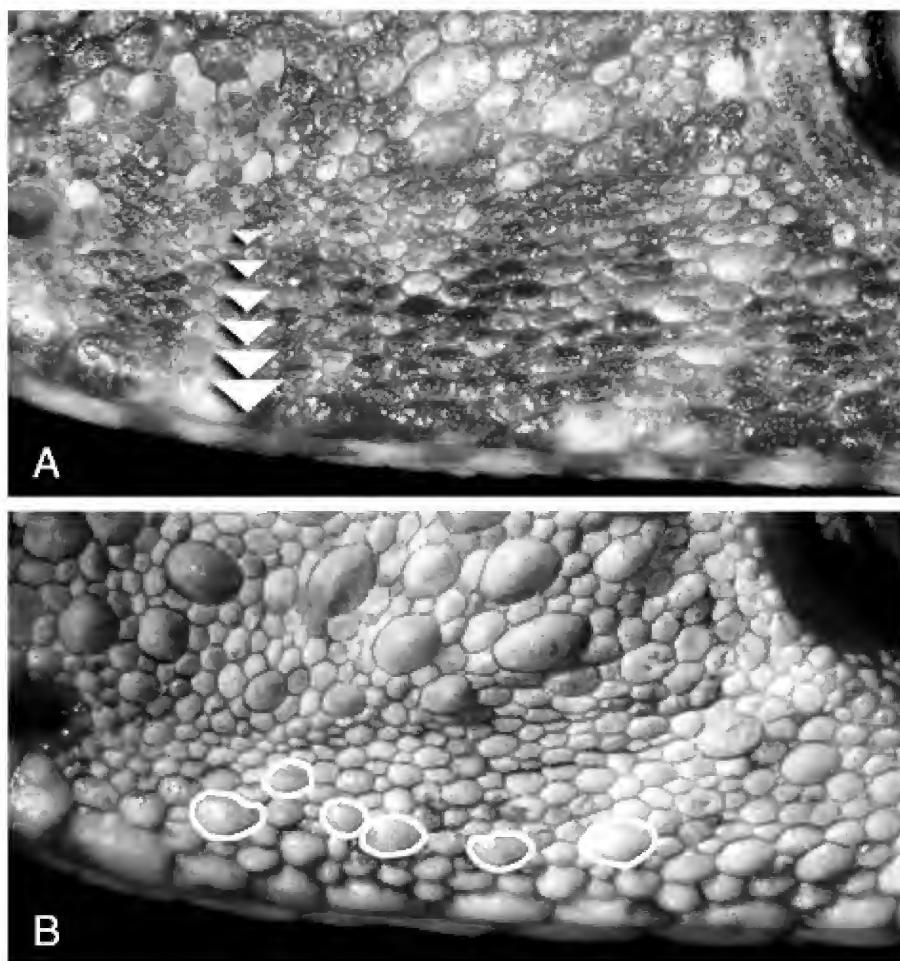


Fig. 9. Scales on snout. (A) grade evenly from large to small (moving up from supralabial row), *Saltuarius kateae* n.sp. AM R164163; (B) heterogeneous, small and large scales intermixed, *S. swaini* QM J8359. Condition (A) also applies for *S. moritzi* n.sp. and *S. wyberba*.

11.9, SD = 1.20). **Neck.** Broad. **Body.** Moderate, depressed, covered in small granules; dorsal granules intermixed with larger conical tubercles; tubercles small to moderate on back and flanks, moderate to pronounced on sides of neck; basal scales surrounding upper flank and back tubercles not, or slightly, larger than adjacent granules; ventral scales enlarged in pelvic region. Preanal pores absent. Axilla slightly to moderately invaginated. **Limbs.** Long, covered in small to moderate pointed tubercles dorsally; lacking enlarged tubercles on ventral surfaces, although some specimens have enlarged granules on the anterior edge of the upper forelimb; digits strongly compressed distally; subdigital lamellae (fourth finger) 17–23 (n = 60, mode = 19, mean = 19.6, SD = 1.43); dorsal surface of hand with (83%) or without (17%) enlarged conical tubercles; dorsal surface of fingers, at least some, with (57%) or without (43%) enlarged spinose scales; subdigital lamellae (fourth toe) 19–26 (n = 62, mode = 24, mean = 22.6, SD = 1.75); dorsal surface of foot with enlarged conical tubercles; dorsal surface of toes, at least some, with enlarged spinose tubercles (Fig. 10B). **Original tail.** Depressed, broad, contracted at base and attenuated at tip; flared portion with undulating flange bearing sharply pointed tubercles along margin; dorsal surface of tail, except vertebral region of flared portion, covered with large conical tubercles; tail tip slender and free of tubercles (Fig. 13A); number of rows of enlarged spinose tubercles

across flared portion of tail 4–7 (n = 27, mode = 6, mean = 5.4, SD = 0.89); number of rows of spinose tubercles across attenuated portion 4–6 (n = 26, mode = 4, mean = 4.3, SD = 0.60); attenuated tip accounts for 29.1–47.3% tail length (n = 28, mean = 39.3, SD = 3.63); ventral surface smooth with a slight depression along midline. **Regenerated tail.** approximately 61%SVL when fully regenerated; depressed, broad and strongly leaf-like, contracted at base with short attenuated tip; slight tapering and folding of lateral flange anteriorly; covered with uniform granules and minute, spinose lateral tubercles.

**Pattern.** In spirit, head body and limbs finely marbled with grey and mid to dark brown blotches; a narrow brown or tan vertebral stripe (edged with dark brown), broken by 3–6 obscure to bold (brown or greyish) cross-bands between fore and hind limbs (bands are often edged with dark brown along the anterior edge). Pattern extremely variable (AM R160420 from Bruxner Park greyish with a dark netted pattern on dorsum; AM R101338 from O'Sullivans Gap dark brown with a paler vertebral stripe and indistinct vertebral blotches). Head usually with deep V-shaped marking back between eyes (Fig. 7B), but this character is variable and the marking may be indistinct and not penetrate deeply between the eyes (Fig. 7C). Snout with obscure, ragged cross-bands; labials pale, but broken by dark brown blotches. Limbs with obscure, broken

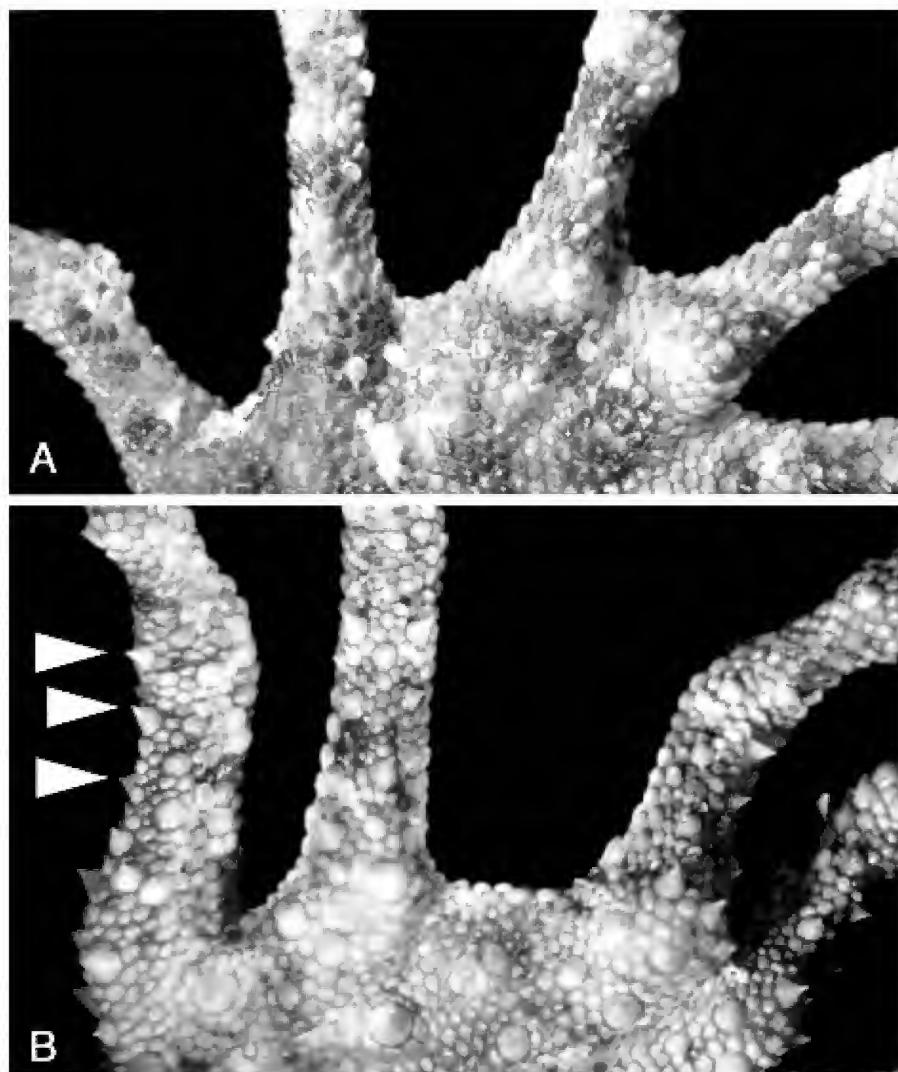


Fig. 10. Dorsal surface of toes. (A) Without enlarged spinose tubercles, *Saltuarius kateae* n.sp. AM R164161; (B) with enlarged spinose tubercles, *S. swaini* QM J54846. Condition (B) also applies for *S. moritzi* n.sp. and *S. wyberba*.

bands; digits banded with dark brown and grey (less visible in darker specimens). Venter cream to pale grey, heavily peppered with fine brown specks. Original tail with irregular pale cross bands (usually 4), these extend to the ventral surface on the attenuated tip. Regenerated tail greyish with dark marbling (mid to dark brown or black) above; ventral surface similar, but may have reduced pigmentation.

**Measurements and scale counts of holotype.** AM R158990 (male) SVL = 109.3 mm, T = 75.8 mm, TT = 30.0 mm, HL = 28.6 mm, HW = 21.8 mm, HD = 8.7 mm, S = 13.5 mm, EE = 8.1 mm, NL = 21.6 mm, L1 = 52.3 mm, L2 = 62.8 mm, AG = 51.0 mm, Lamellae 4th finger 20, Lamellae 4th toe 22, supralabials 12, infralabials 13, scales contacting posterior edge of mental 4.

**Genetics.** *Saltuarius moritzi* n.sp. differs in cytochrome *b* sequences from other members of the “*S. swaini*” lineage at 10.59–13.01% of sites (Table 1). It differs from its northern congeners *S. cornutus* and *S. salebrosus* at 22.19% and 18.45% of sites respectively. Average intraspecific sequence divergence is 4.69% (Table 1).

**Distribution.** Widespread south of the Clarence River between latitudes 29°50'S and 32°32'S. Its distribution extends from coastal areas west through the gorge systems of the New England Tableland (Fig. 11).

**Geology.** *Saltuarius moritzi* n.sp. occurs in the New England Block, a complex mosaic of Tertiary basalts, intrusive granites and rocks of Silurian, Carboniferous and Permian age. These include sediments of both continental and marine origins.

**Habitat.** Wet sclerophyll forests, on the trunks of Flooded Gums and the bases of hollow, dead trees, at Coffs Harbour and O’Sullivans Gap (near Bulahdelah); in closed forests on the bases of emergent *Tristaniopsis* sp. at Boorganna Nature Reserve (Comboyne Plateau) and on rock (outcrops, escarpments and gorges) at Sherwood Nature Reserve (Fig. 14A, near Glenreagh), Ebor Falls (Fig. 14B) and Blue Hole (near Armidale).

**Comparison with other species.** *Saltuarius moritzi* n.sp. is readily distinguished from *S. cornutus* and *S. salebrosus*

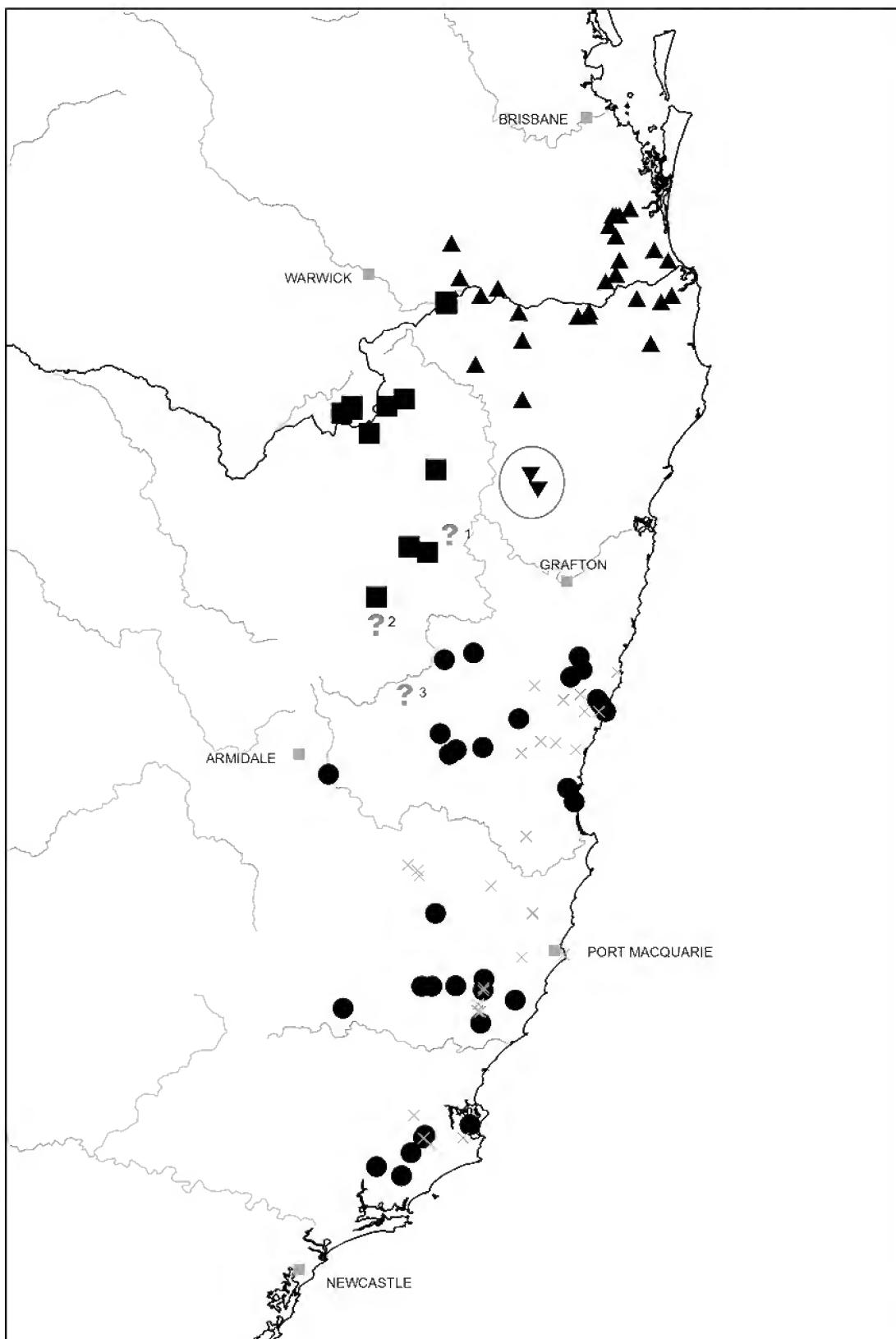


Fig. 11. Distribution for “*Saltuarius swaini*” lineage in southeastern Queensland and northeastern New South Wales. ▲ = *S. swaini*; ▼ = *S. kateae* n.sp.; ■ = *S. wyberba*; ● = *S. moritzi* n.sp.; × = *Saltuarius* records, presumably *S. moritzi* n.sp., from the NSW National Parks and Wildlife Service database; ?1, ?2, ?3 = QM J72343, AM R143592 and AM R43870 respectively—see *Results* and *Future directions* for further discussion. The species’ symbols correspond with those used in Figs 2–4.

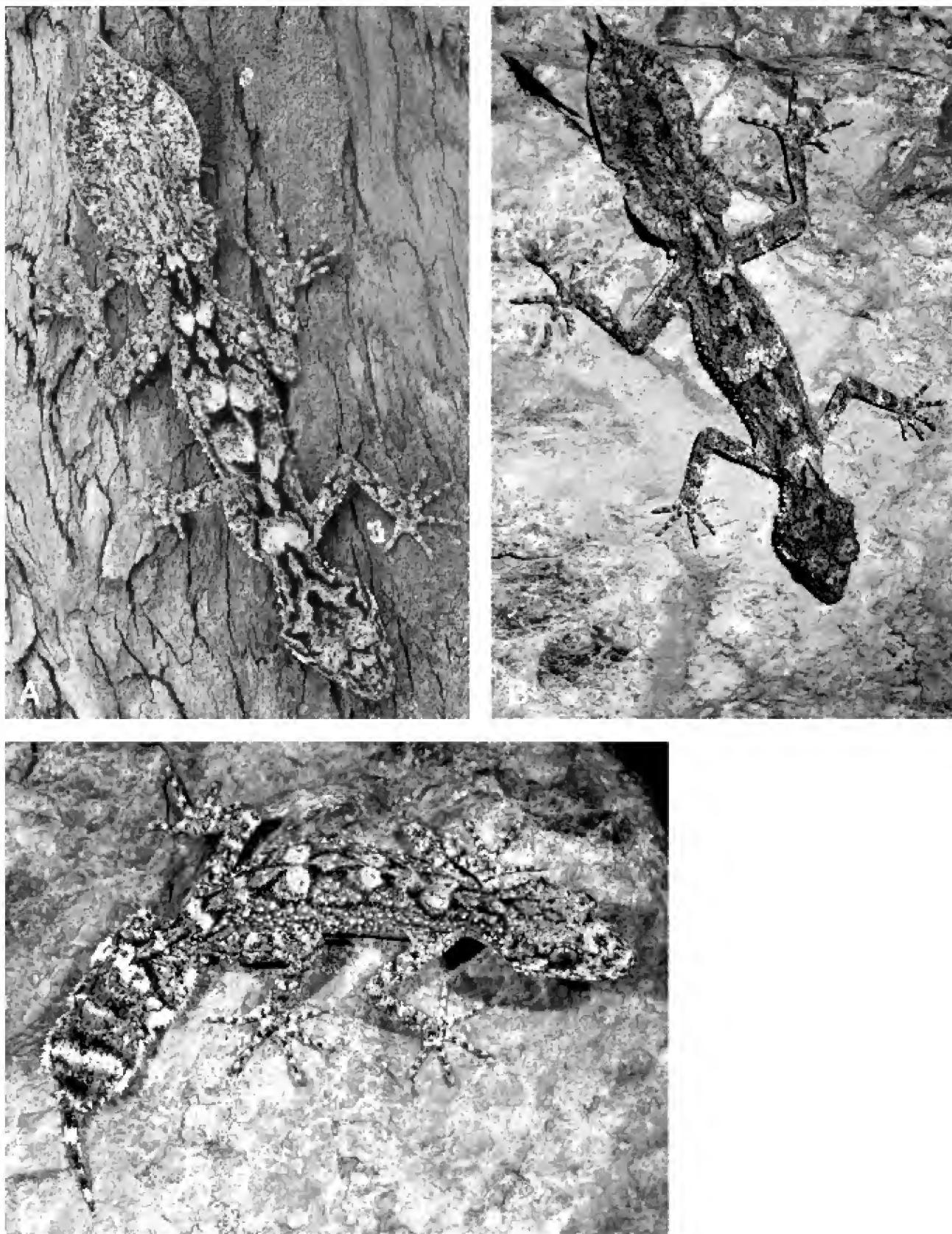


Fig. 12. Variation of colour and pattern in *Saltuarius moritzi* n.sp. (A) AM R160420, Bruxner Park, near Coffs Harbour (30°14'30"S 153°05'36"E) NSW (photograph—Jeff Wright, QM); (B) Ebor Falls (30°24'19"S 152°20'20"E) NSW (photograph—Glenn Shea); (C) QM J83588, Blue Hole, SE Armidale on upper reaches of Gara River (30°36'00"S 151°48'09"E) NSW (photograph—Ross Sadlier, AM).

in lacking preanal pores in both sexes (vs present in males). It is further distinguished from *S. cornutus* by its lower flank tubercles (tubercles not hooked and not surrounded by smaller spines *vs* tubercles hooked and surrounded by smaller spines) and from *S. salebrosus* by its throat scalation (throat smooth *vs* throat strongly tuberculate). It is most similar to *S. wyberba*. Colour pattern most readily distinguishes these species (Figs 12A,B,C and 15A,B), although both exhibit some variability. *Saltuarius moritzi* n.sp. usually has two clearly defined, narrow, pale bands across the flared portion of the original tail and these are continuous through the vertebral region (Fig. 13A; *vs* anterior band may be obscure, often centred on enlarged tubercles and usually discontinuous through vertebral region, Fig. 13B); the dark bands across the snout and other dark head markings are not usually sharply contrasted with the base colour (*vs* dark head markings often in sharp contrast with base colour) and the V-shaped marking between the eyes is usually narrow and deep (Fig. 7B; *vs* usually wide and shallow, Fig. 7E). *Saltuarius moritzi* n.sp. also tends to be deeper headed than *S. wyberba* (mean HD = 42% HW *vs* 39% HW). It is distinguished from *S. swaini* in having narrow pale bands across the flared portion of the original tail (*vs* broad cream/grey zones, Fig. 13C); by its smaller size (max SVL = 109 mm *vs* 134 mm) and by the arrangement of the snout scales (grade evenly from small to large in dorsal–ventral transect, Fig. 9A *vs* intermixed with larger granules above the supralabials, Fig. 9B). From *S. kateae* n.sp. it is readily distinguished by the rostral/nostril contact (rostral usually in contact with nostril, Fig. 8B *vs* rostral usually excluded from nostril, Fig. 8A) and by the spinosity of the digits (dorsal surface of digits with spinose tubercles, Fig. 10B *vs* spinose tubercles absent, Fig. 10A).

**Remarks.** Specimen AM R158990 was selected as the holotype of *S. moritzi* n.sp. despite it lying on the morphological boundary of *S. swaini* in the discriminant functions analyses (Fig. 4). This specimen comes from a genetically typed population. It is geographically and genetically remote from *S. swaini*, is well-preserved, adult-sized, possesses an original tail, and displays pattern details characteristic of *S. moritzi* n.sp.

The specimens listed as “additional material examined” are problematic and hence they are excluded from the type series and their morphometrics have been excluded from this species account. Specimen AM R141966 from Grange State Forest (29°27'03"S 152°23'06"E) is excluded (despite its genetic assignment to *S. moritzi* n.sp.—see phylogeny, Fig. 1) for a number of reasons. Firstly, the co-ordinates provided by the collector (see above) do not correspond closely with those of Grange SF (29°28'S 152°34'E, Anon., 1975) and place the specimen geographically between the Mt Spirabo and Gibalter Range *S. wyberba* populations. Secondly, AM R141966 was processed (tissues sample, specimen fixed and registered) in the same series as AM R141964 from Chaelundi State Forest (30°01'07"S 152°30'02"E). It shows no genetic divergence from this specimen despite a geographic separation of 60 kms or more. Leaf-tail geckos are known to occur at Chaelundi SF (see Couper *et al.*, 1997) and the possibility that both specimens originated from this site cannot be overlooked. Verification of the presence of leaf-tailed geckos in Grange SF and their genetic similarity to Chaelundi populations requires additional survey effort.

Specimens QM J72343 (Blady Grass Ck, approx 1 km upstream of junction with Henry River, SE of Glen Innes (29°50'49"S 152°00'08"E) NSW; Fig. 11: ?1), AM R143592 (Oakwood SF, Oakwood Fire Trail, at Willys Ck (29°52'58"S 152°01'54"E) NSW; Fig. 11: ??) and AM R43870 (Guyra, 22 miles E (30°13'03"S 152°10'05"E) NSW; Fig. 11: ?3) are excluded (despite the genetic assignment of one, QM J72343 to *S. moritzi* n.sp.) because they were identified as *S. wyberba* in the discriminant analysis (see “future directions” in discussion). Specimens AM R150911–12 come from Giro SF, a region not genetically studied. One of these, AM R150912 was identified as *S. swaini* by the discriminant analysis. Giro SF is well within the known range of *S. moritzi* n.sp. and both specimens are consistent with this species in colour pattern and the arrangement of the snout scales above the anterior supralabials.

### *Saltuarius swaini* (Wells & Wellington, 1985), revised description

Fig. 16

**Material examined.** QM J12257 Tamborine (27°53'S 153°15'E) SEQ; QM J398, QM J2409, QM J2933–34, QM J3254, QM J4439, QM J8183, QM J8359, QM J8861, QM J10440 Mt Tamborine (27°55'S 153°10'E) SEQ; QM J51095 Mt Tamborine (27°55'S 153°11'E) SEQ; QM J4819 Tamborine Mtn, Eagle Hts (27°55'S 153°12'E) SEQ; QM J148 Canungra Ck (27°58'S 153°09'E) SEQ; QM J3215 Canungra (28°01'S 153°11'E) SEQ; QM J80792, Mt Mitchell, Cunninghams Gap, Main Range NP (28°03'06"S 152°23'38"E) SEQ; QM J80793, QM J81611, Mt Cordeaux, Cunninghams Gap, Main Range NP (28°03'06"S 152°23'38"E) SEQ; QM J4198, QM J5690 Mudgeeraba (28°05'S 153°22'E) SEQ; QM J5649 Flying Fox Valley, Beechmont (28°08'S 153°12'E) SEQ; QM J3313 Tallebudgera (28°08'S 153°26'E) SEQ; QM J8646 Lamington NP, Binna Burra (28°12'S 153°11'E) SEQ; QM J5382 Lamington NP (28°12'S 153°05'E) SEQ; QM J51094 Mt Superbus SF, via Warwick (28°13'S 152°28"E) SEQ; AM R97823 Mt Superbus (28°13'S 152°26'E) SEQ; QM J51637–40 Lamington NP, O'Reillys (28°14'S 153°08'E) SEQ; QM J23937 near Mt Ballow (28°16'S 152°37'E) SEQ; QM J8074, QM J8099 Mt Clunie, Boonah (28°18'S 152°32'E) NSW; QM J1143 Tweed River (28°18'S 153°27'E) NSW; QM J5757 Chillingham, Murwillumbah (28°19'S 153°17'E) NSW; AM R2409 Murwillumbah, Tweed River (28°20'S 153°24'E) NSW; AM R158987 Border Ranges NP, vicinity of Brindle Ck rest area (28°22'37"S 153°03'14"E) NSW; QM J10565 Mt Lindesay (28°23'S 152°43'E) SEQ; QM J54846 Brays Ck, Border Ranges NP (28°24'S 153°03'E) NSW; AM R98333, QM J83594, AM R160423 Mt Warning NP (28°24'05"S 153°16'54"E) NSW; AM R116978 (holotype) Richmond Range SF (28°31'S 152°44'E) NSW; AM R11860 Huonbrook (28°32'S 153°21'E) NSW; AM R92122 6 km NW of Amiens (28°34'S 151°46'E) SEQ; AM R130911 Yabba SF (28°37'57"S 152°30'32"E) NSW; AM R158999 Cambridge Plateau NP, Richmond Range (28°48'S 152°44'E) NSW.

**Diagnosis.** A large, slender-bodied *Saltuarius* (maximum SVL 134 mm) with smooth throat scales, no preanal pores (in either sex) and a prominent, narrow V-shaped marking

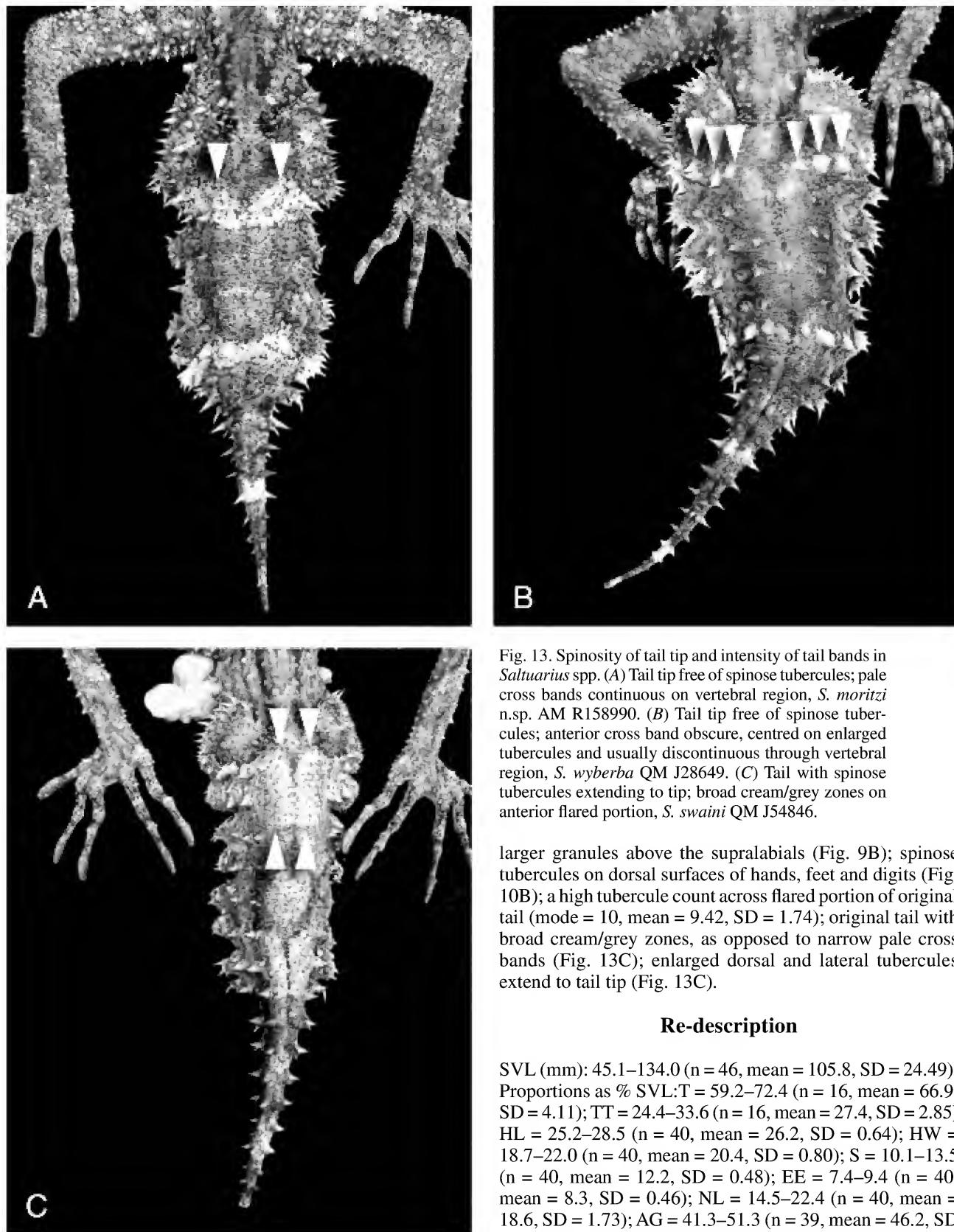


Fig. 13. Spinosity of tail tip and intensity of tail bands in *Saltuarius* spp. (A) Tail tip free of spinose tubercles; pale cross bands continuous on vertebral region, *S. moritzi* n.sp. AM R158990. (B) Tail tip free of spinose tubercles; anterior cross band obscure, centred on enlarged tubercles and usually discontinuous through vertebral region, *S. wyberba* QM J28649. (C) Tail with spinose tubercles extending to tip; broad cream/grey zones on anterior flared portion, *S. swaini* QM J54846.

larger granules above the supralabials (Fig. 9B); spinose tubercles on dorsal surfaces of hands, feet and digits (Fig. 10B); a high tubercle count across flared portion of original tail (mode = 10, mean = 9.42, SD = 1.74); original tail with broad cream/grey zones, as opposed to narrow pale cross bands (Fig. 13C); enlarged dorsal and lateral tubercles extend to tail tip (Fig. 13C).

#### Re-description

SVL (mm): 45.1–134.0 (n = 46, mean = 105.8, SD = 24.49). Proportions as % SVL:T = 59.2–72.4 (n = 16, mean = 66.9, SD = 4.11); TT = 24.4–33.6 (n = 16, mean = 27.4, SD = 2.85) HL = 25.2–28.5 (n = 40, mean = 26.2, SD = 0.64); HW = 18.7–22.0 (n = 40, mean = 20.4, SD = 0.80); S = 10.1–13.5 (n = 40, mean = 12.2, SD = 0.48); EE = 7.4–9.4 (n = 40, mean = 8.3, SD = 0.46); NL = 14.5–22.4 (n = 40, mean = 18.6, SD = 1.73); AG = 41.3–51.3 (n = 39, mean = 46.2, SD = 2.30); L1 = 44.0–51.1 (n = 36, mean = 48.2, SD = 1.60); L2 = 53.2–62.3 (n = 36, mean = 58.7, SD = 2.24).

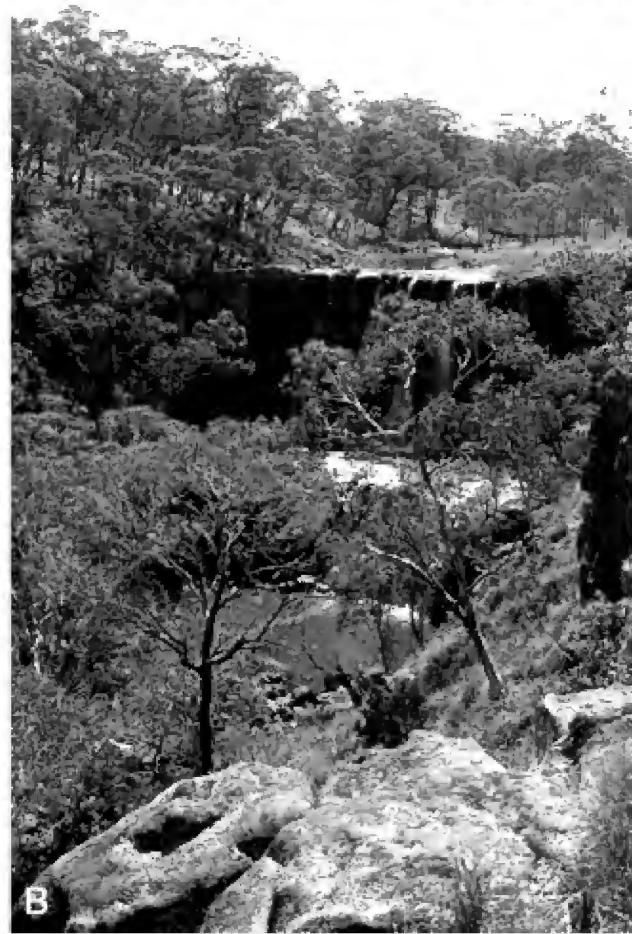
**Head.** Large, depressed, triangular, distinct from neck; head depth 39.6–51.0% head width (n = 46, mean = 43.9, SD = 2.68); covered in small granules which are intermixed with

running back deeply between the eyes (Fig. 7D). It is distinguished from its congeners by the following combined characters: rostral shield usually in contact with nostril (Fig. 8B); scales on snout do not usually grade evenly from small to large (in dorsal–ventral transect), but are intermixed with

Fig. 14. Rock habitats of *Saltuarius moritzi* n.sp. at (A) Sherwood Nature Reserve ( $30^{\circ}02'10''S$   $153^{\circ}00'26''E$ ); (B) Ebor Falls ( $30^{\circ}24'19''S$   $152^{\circ}20'20''E$ ). (Photographs—R. Sadlier, AM).



A



B

larger conical tubercles; skin of head co-ossified with skull; rostral shield fully divided by deep, vertical groove ( $n = 46$ ), or divided into three ( $n = 2$ ); rostral shield contacting nostril (Fig. 8B); scales contacting posterior margin of mental shield 3–8 ( $n = 45$ , mode = 6, mean = 5.4, SD = 1.14); ear opening elliptical, vertical, much less than half as large as eye; supralabials 12–18 ( $n = 46$ , mode = 14, mean = 14.9, SD = 1.53); scale rows on the snout, immediately above the anterior supralabials, do not grade evenly from large to small, but are intermixed with larger scales (Fig. 9B) in 84.8% of specimens, condition ambiguous in 15.2% of specimens; infralabials 9–16 ( $n = 46$ , mode = 12, mean = 12.8, SD = 1.45). *Neck*. Broad. *Body*. Moderate, depressed, covered in small granules; dorsal granules intermixed with larger conical tubercles; tubercles moderate to large on body and neck; basal scales surrounding upper flank and back tubercles noticeably larger than adjacent granules; ventral scales enlarged in pectoral and pelvic regions. Preanal pores absent. Axilla slightly to moderately invaginated. *Limbs*. Long, covered in moderate pointed tubercles dorsally; lacking enlarged tubercles on ventral surfaces, although some specimens have enlarged granules on the anterior edge of the upper forelimb; digits strongly compressed distally; subdigital lamellae (fourth finger) 18–26 ( $n = 46$ , mode = 22, mean = 21.5, SD = 1.64); dorsal surface of hand and fingers with enlarged conical tubercles; subdigital lamellae (fourth toe) 20–28 ( $n = 46$ , mode = 23, mean = 24.0, SD = 1.71); dorsal surface of foot and toes with enlarged conical tubercles (Fig. 10B). *Original tail*. Depressed, broad, contracted at base and attenuated at tip; flared portion with undulating flange bearing sharply pointed tubercles along margin; dorsal surface of tail, except vertebral region of flared portion, covered with large conical tubercles; tail tip slender, with sharp tubercles extending almost to tip (Fig. 13C); number of rows of enlarged spinose tubercles across flared portion of tail 6–13 ( $n = 19$ , mode = 10, mean = 9.4, SD = 1.74); number of rows of spinose tubercles across attenuated portion of tail 5–10 ( $n = 19$ , mode = 6, mean = 6.4, SD = 1.16); attenuated tip accounts for 35.3–49.3% tail length ( $n = 19$ , mean = 40.6, SD = 3.41); ventral surface smooth with a slight depression along midline. *Regenerated*

*tail*. Approximately 55%SVL when fully regenerated; depressed, broad and strongly leaf-like, contracted at base with short attenuated tip; slight tapering and folding of lateral flange anteriorly; covered with uniform granules and minute, spinose lateral tubercles.

**Pattern.** The pattern description provided by Couper *et al.* (1993) for this species included specimens of *S. moritzi* n.sp. In spirit, head, body and limbs grey to mid-brown; a

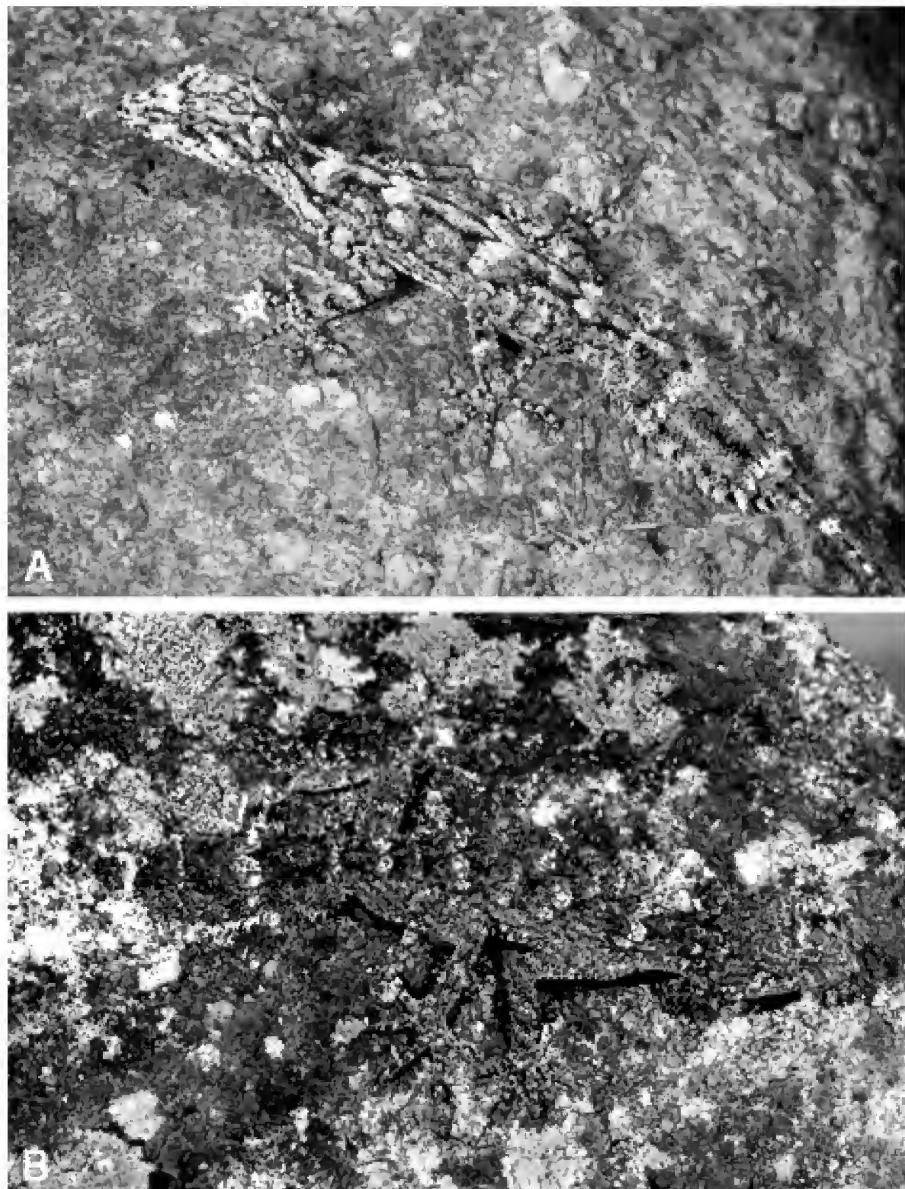


Fig. 15. *Saltuarius wyberba* (A) Girraween NP (28°51'S 151°55'E) SEQ (photograph—Jeff Wright, QM); (B) AM R164152, Gibraltar Range NP, Gwydir Hwy, 4.2 km W rangers station (29°32'06"S 152°16'43"E) NSW (photograph—Ross Sadlier, AM).

tan vertebral stripe (edged with dark brown), broken by 3–5 grey cross bands between fore and hind limbs. Head with pronounced, deep V-shaped marking running back between eyes (Fig. 7D) and obscure, ragged cross-bands sometimes present on snout; labials pale, broken by dark brown blotches. Limbs often with obscure broken bands; digits faintly banded. Venter cream to pale grey, marked by small clusters of brown scales (faint to heavy); some specimens with obscure dark barring beneath lower jaw, near angle of mouth. Original tail with grey to brown vertebral zone; dark “lichen-like” blotches on basal, medial and distal portions (broad cream/grey zones on anterior flared portion, Fig. 13C, as opposed to narrow pale cross bands, Fig. 13A,B); pale bands on tail tip obscure, extend to ventral surface. Regenerated tail grey to tan with darker brown marbling above; ventral surface with reduced pigmentation.

**Measurements and scale counts of holotype.** The measurements provided by Wells and Wellington (1985) vary slightly from those in the current study.

AM R116978 (female) SVL = 124.5 mm, T(regrown) = 57.3 mm, HL = 32.5 mm, HW = 25.6 mm, HD = 11.8 mm, S = 14.79 mm, EE = 10.7 mm, NL = 22.5 mm, L1 = 58.3 mm, L2 = 68.1 mm, AG = 62.8 mm, Lamellae 4th finger 21, Lamellae 4th toe 25, supralabials 15, infralabials 13, scales contacting posterior edge of mental 7.

**Genetics.** *Saltuarius swaini* differs in cytochrome *b* sequences from other members of the “*S. swaini*” lineage at 13.01–14.37% of sites (Table 1). It differs from its northern congeners *S. cornutus* and *S. salebrosus* at 22.65% and 19.38% of sites respectively. Average intraspecific sequence divergence is .73% (Table 1).



Fig. 16. AM R160423, *Saltuarius swaini*, Mt. Warning NP (28°24'05"S 153°16'54"E) NSW (photograph—Jeff Wright, QM).

**Distribution.** Occurs in the coastal ranges of southeast Queensland and northern NSW between latitudes 27°53'S–28°48'S. All NSW populations occur east of the Clarence River (Fig. 11).

**Geology.** The distribution of *S. swaini* lies within the Clarence-Moreton Basin centred on the Main Range, Focal Peak and Mt Warning-Tweed Volcanics and smaller outliers of these blocks. These formations are largely basalt of Miocene age.

**Habitat.** Subtropical rainforests, often in association with strangler figs and the buttressed roots of large trees.

**Comparison with other species.** *Saltuarius swaini* is readily distinguished from *S. cornutus* and *S. salebrosus* in lacking preanal pores in both sexes (vs present in males). It is further distinguished from *S. cornutus* by its lower flank tubercles (tubercles not hooked and not surrounded by smaller spines vs tubercles hooked and surrounded by smaller spines) and from *S. salebrosus* by its throat scalation (throat smooth vs throat strongly tuberculate). It is most similar to *S. moritzi* n.sp., *S. kateae* n.sp. and *S. wyberba*, but larger (max SVL = 134 mm vs 109 mm, 105 mm and 108 mm respectively). It is further separated by the scales on the snout (dorsal-ventral transect): intermixed with larger granules above the supralabials (Fig. 9B) vs even gradation from small to large

(Fig. 9A). *Saltuarius swaini* lacks the narrow pale bands that are present on the flared portion of the original tails of *S. moritzi* n.sp. and *S. wyberba* (original tail pattern could not be assessed for *S. kateae* n.sp.) and these appear as two broad cream/grey zones (Fig. 13C). From *S. kateae* n.sp., it is further separated by the rostral/nostril contact (rostral usually contacts nostril, Fig. 8B vs rostral usually excluded from nostril, Fig. 8A) and the spinosity of the digits (dorsal surface of digits with spinose tubercles, Fig. 10B vs tubercles absent, Fig. 10A).

**Remarks.** Specimen AM R92122 (listed in material examined) remains problematic. This animal was identified by Couper *et al.* (1994) as belonging to the “rainforest” colour form of *S. swaini* (= *S. swaini* sensu stricto) despite its close geographic proximity to “eucalypt-granite” populations that were later described as *S. wyberba* (Couper *et al.*, 1997). The discriminant analysis herein, further supports the identification of AM R92122 as *S. swaini*, but the locality for this specimen, “6 km NW Amiens” is not compatible with current knowledge of the habitat requirements and geological associations of this taxon. Consequently, this locality should be treated with caution.

### *Saltuarius wyberba* Couper, Schneider & Covacevich, 1997, revised description

Fig. 15A,B

**Material examined.** QM J70465 Queen Mary Falls, top, near Killarney (28°20'S 152°22'E) SEQ; QM J80794 Queen Mary Falls NP (28°20'30"S 152°22'10"E) SEQ; QM J80795 Queen Mary Falls NP (28°20'29"S 152°22'14"E) SEQ; QM J80796 Queen Mary Falls NP (28°20'31"S 152°22'16"E) SEQ; AM R110510 1.5 km NW Amiens (28°34'S 141°46'E) SEQ; QM J35401 Boonoo Boonoo Falls, via Tenterfield (28°48'S 152°10'E) NSW; QM27349 near Girraween (28°50'S 151°55'E) SEQ; QM J25374 Girraween NP, via Stanthorpe (28°50'S 151°55'E) SEQ; QM J61539–45 Girraween NP, 1.5 km from Bald Rock camp ground (28°50'S 151°56'E) SEQ; QM J28648–49 Girraween area, near Wyberba (28°50'S 151°55'E) SEQ; QM J51633–36 Girraween NP, Natural Arch track (28°50'S 151°55'E) SEQ; QM J50345 Girraween NP (28°51'S 151°55'E) SEQ; QM J29116–17 Stanthorpe area, ?Girraween (28°50'S 151°55'E) SEQ; QM J51093 Girraween NP, edge, outside park (28°50'S 151°56'E) SEQ; QM J30677 Stanthorpe, Aztec Temples, near Underground River (28°50'S 152°05'E) SEQ; QM J54847 Bookookoorara, Boonoo SF (28°50'S 152°02'E) NSW; QM J30420 near Wyberba (28°52'S 151°52'E) SEQ; QM J68108 Basket Ck, S of Bald Mountain NP (28°58'S 152°00'E) NSW; AM R156806 Timbarra Plateau (29°08'17"S 152°19'09"E), NSW; AM R149768 Curramore SF, 6.1 km SE along Black Hole Trail, at Black Hole Ck (29°30'30"S 152°11'24"E) NSW; QM J83586–87, AM R164152–53, AM R164155, AM R164157 Gibraltar Range NP, Gwydir Hwy, 4.2 km W rangers station (29°32'06"S 152°16'43"E) NSW; QM J53984 Teapot Ck, Narrow Pass Fire Trail, Mann River NR (29°45'S 152°02'E) NSW; QM J79754–55, QM J79757–58 no data.

**Diagnosis.** A medium-sized *Saltuarius* (maximum SVL 108 mm) with smooth throat scales, no preanal pores in either sex

and usually a wide, shallow V-shaped marking between the eyes (Fig. 7E). It is distinguished from its congeners by the following suite of characters: rostral shield usually contacts nostril (Fig. 8B); dorsal surface of toes usually with large spinose tubercles (Fig. 10B); scales on snout usually grade evenly from small to large (in dorsal–ventral transect) (Fig. 9A), not intermixed with larger granules above the supralabials; two narrow pale bands across the flared portion of the original tail, anterior-most usually broken in vertebral region (Fig. 13B); enlarged dorsal and lateral tubercles usually do not extend to tail tip (Fig. 13B); dark markings on head usually strongly contrasting with base colour and mean HD < 40% HW.

### Re-description

SVL (mm): 58.3–107.7 (n = 41, mean = 92.8, SD = 10.04). Proportions as % SVL: T = 62.3–80.7 (n = 14, mean = 71.2, SD = 4.32); TT = 20.7–36.8 (n = 14, mean = 29.0, SD = 4.07); HL = 24.7–29.3 (n = 36, mean = 27.3, SD = 0.97); HW = 19.8–23.9 (n = 36, mean = 22.1, SD = 0.95); S = 11.0–13.7 (n = 36, mean = 12.1, SD = 0.49); EE = 7.5–10.0 (n = 36, mean = 8.9, SD = 0.63); NL = 15.1–21.3 (n = 35, mean = 17.7, SD = 1.46); AG = 39.9–48.3 (n = 36, mean = 45.0, SD = 1.91); L1 = 44.0–50.9 (n = 35, mean = 47.2, SD = 1.92); L2 = 53.1–63.3 (n = 34, mean = 57.4, SD = 2.50).

**Head.** Large, depressed, triangular, distinct from neck; head depth 36.2–42.3% head width (n = 36, mean = 39.2, SD = 1.67); covered in small granules which are intermixed with larger conical tubercles; skin of head co-ossified with skull; rostral shield fully divided by deep, vertical groove (n = 38), only half divided (n = 1), divided into three (n = 1) or not divided (n = 1); rostral shield contacting nostril (Fig. 8B, n = 37), narrowly excluded from nostril on one side (n = 3) or not contacting nostril (n = 1); scales contacting posterior margin of mental shield 4–11 (n = 40, mode = 6, mean = 6.0, SD = 1.42); ear opening elliptical, vertical, much less than half as large as eye; supralabials 11–18 (n = 41, mode = 14, mean = 14.5, SD = 1.43); scales on snout grade evenly from small to large (in dorsal–ventral transect; Fig. 9A); infralabials 10–15 (n = 41, mode = 12, mean = 12.3, SD = 1.10). **Neck.** Broad. **Body.** Moderate, depressed, covered in small granules; dorsal granules intermixed with larger conical tubercles; tubercles moderate on body and large on neck; basal scales surrounding upper flank and back tubercles noticeably larger than adjacent granules; ventral scales enlarged in pelvic region. Preanal pores absent. Axilla slightly to moderately invaginated. **Limbs.** Long, covered in moderate pointed tubercles dorsally; lacking enlarged tubercles on ventral surfaces; digits strongly compressed distally; subdigital lamellae (fourth finger) 16–24 (n = 41, mode = 18, mean = 19.2, SD = 1.61); dorsal surface of hand with (88%) or without (12%) enlarged conical tubercles; dorsal surface of some fingers with (45%) or without (55%) enlarged spinose scales; subdigital lamellae (fourth toe) 19–25 (n = 41, mode = 20, mean = 21.6, SD = 1.66); dorsal surface of foot with enlarged conical tubercles; dorsal surface of some toes usually with (95%) enlarged spinose tubercles (Fig. 10B; sharp in 61% of specimens, blunt in 39% of specimens). **Original tail.** Depressed, broad, contracted at base and attenuated at tip; flared portion with undulating flange bearing sharply pointed tubercles along margin; dorsal surface of tail, except

vertebral region of flared portion, covered with large conical tubercles; tail tip slender and free of tubercles, or with only minute tubercles (Stanthorpe area and further south, Fig. 13B), or tail more bluntly tipped (Queen Mary Falls population) with tubercles almost to tip; number of rows of enlarged spinose tubercles across flared portion of tail 4–8 ( $n = 14$ , mode = 6, mean = 5.6, SD = 1.21); number of rows of spinose tubercles across attenuated portion of tail 4–7 ( $n = 14$ , mode = 6, mean = 5.4, SD = 0.94); attenuated tip accounts for 33.17–46.23% tail length ( $n = 14$ , mean = 40.6, SD = 3.92); ventral surface smooth with a slight depression along midline. *Regenerated tail*. Approximately 58% SVL when fully regenerated; depressed, broad and strongly leaf-like, contracted at base with short attenuated tip; slight tapering and folding of lateral flange anteriorly; covered with uniform granules and minute, spinose lateral tubercles.

**Pattern.** In spirit, Couper *et al.* (1997) provide the following description of body colour pattern for *S. wyberba*: “Dorsum tan or grey; heavily marked with dark brown/black or grey blotches on head, body and limbs; a narrow vertebral stripe, broken by four irregular tan or grey blotches, extends from neck to base of tail; a wide, open V-shaped marking between the eyes (Fig. 3a); labials light grey, mottled with dark brown; limbs moderately boldly banded; toes prominently banded. Venter cream with clusters of dark brown granules which often form irregular bars below the infralabials and on the anterior margin of the thigh.” This description stands to define the populations in the Stanthorpe area, SEQ. The Queen Mary Falls population is generally consistent with the above description, but the blotches across the vertebral stripe tend to be less pronounced and the “V” between the eyes can be finer and more “swaini-like” in some individuals. The Gibralter Range animals are darker, and hence more uniform in appearance. The vertebral blotches are more restricted and may not extend to the dorsolateral area as in the northern populations. The degree of dark peppering on the ventral surface is also less pronounced. All populations have a series (usually 4) of pale, irregular crossbands on the original tail and these extend to the ventral surface of the attenuated tip. Regenerated tails show considerable variation in base colour and degree of darker marbling.

**Measurements and scale counts of holotype.** See Couper *et al.*, 1997.

**Geology.** *Saltuarius wyberba* is largely associated with outcropping of Middle Permian to Early Triassic granitoids in southeastern Queensland and northeastern NSW (for extent of granite occurrence see map in Schaltegger *et al.*, 2005). The Queen Mary Falls population occurs on the southwestern flank of the Main Range Volcano where the geckos are found on a cliff-line of Trachyte with an underlying layer of basalt. These formations are only narrowly separated from the broader granite outcrops of the Stanthorpe region.

**Genetics.** *Saltuarius wyberba* differs in cytochrome *b* sequences from other members of the “*S. swaini*” lineage at 10.59–14.37% of sites (Table 1). It differs from its northern congeners *S. cornutus* and *S. salebrosus* at 24.52% and 19.57% of sites respectively. Average intraspecific sequence divergence is 3.17% (Table 1).

**Distribution.** Queensland and northern NSW between latitudes 28°20'S–29°45'S. The most southerly Queensland populations and all NSW populations lie on the western side of the Clarence River. The Queen Mary Falls population (Queensland, northern limit of range) lies in the headwaters of the Condamine River (Fig. 11).

**Habitat.** Associated with granite outcropping in open forest communities.

**Comparison with other species.** *Saltuarius wyberba* is readily distinguished from *S. cornutus* and *S. salebrosus* in lacking preanal pores in both sexes (vs present in males). It is further distinguished from *S. cornutus* by its lower flank tubercles (tubercles not hooked and not surrounded by smaller spines vs tubercles hooked and surrounded by smaller spines) and from *S. salebrosus* by its throat scalation (throat smooth vs throat strongly tuberculate). It is most similar to *S. moritzi* n.sp. and colour pattern most readily distinguishes these species, although both are quite variable. *Saltuarius wyberba* usually has two, narrow pale bands across the flared portion of the original tail, the anterior-most may be obscure, often centred on enlarged tubercles and usually discontinuous through vertebral region (Fig. 13B; vs anterior band well defined and usually continuous through the vertebral region, Fig. 13A); the dark bands across the snout and other dark head markings are usually sharply contrasted with the base colour (vs dark head markings not usually sharply contrasted with base colour) and the V-shaped marking between the eyes is usually wide and shallow (Fig. 7E; vs usually narrow and deep, Fig. 7B). *Saltuarius wyberba* also tends to be more dorsoventrally compressed than *S. moritzi* n.sp. (mean HD = 39% HW vs 42%). It is distinguished from *S. swaini* in having narrow, pale bands across the flared portion of the original tail (Fig. 13B; vs broad cream/grey zones, Fig. 13C); by its smaller size (max SVL = 108 mm vs 134 mm) and the arrangement of the snout scales (grade evenly from small to large in dorsal–ventral transect, Fig. 9A vs intermixed with larger granules above the supralabials, Fig. 9B). From *S. kateae* n.sp. it is readily distinguished by the rostral/nostril contact (rostral usually in contact with nostril, Fig. 8B vs rostral usually excluded from nostril, Fig. 8A) and by the spinosity of the digits (dorsal surface of digits usually with spinose tubercles, Fig. 10B vs spinose tubercles absent, Fig. 10A).

**Remarks.** Specimen QM J53984 (Mann River Nature Reserve; see specimens examined) is not incorporated into the above description. Pattern irregularities and a close geographic proximity to specimens that were genetically typed as *S. moritzi*, but considered to be *S. wyberba* in the discriminant analysis (see “remarks” for *S. moritzi* and “future directions” in discussion) hinder a precise taxonomic assignment. If this specimen proves to be *S. wyberba*, it represents the most southerly record.

## Discussion

**Biogeography.** The three basal lineages in our phylogeny (Fig. 1) are all rainforest inhabitants. *Saltuarius cornutus* and *S. swaini* sensu stricto are both restricted to moist, upland rainforests, the former in northeastern Queensland (NEQ), the latter in SEQ and northern NSW. *Saltuarius*

*salebrosus* extends from the subtropical rainforests (complex notophyll vine forests) of mid-eastern Queensland, west to the sandstone areas (Blackdown Tableland and Injune) of Central Queensland. Despite its presence in dry, inland areas, this taxon is closely associated with softwood scrubs (dry rainforests), now largely cleared. Where *S. salebrosus* occurs on sandstone and granite rock-faces, there are often pockets of softwood scrub clinging to the gullies and talus slopes of these landforms. In view of these associations, it seems reasonable to suggest that *Saltuarius* spp. are derived from a common rainforest ancestor.

The molecular data provide a time frame for interpreting the phylogeography of the “*S. swaini*” lineage. In an earlier study (Couper *et al.*, 2000), divergence between mtDNA lineages within the leaf-tailed geckos was calibrated by C. Schneider to accrue at the rate of  $0.0042 \pm 0.0002$  per million years. Using this calibration, we infer that divergence between the four clades of the “*S. swaini*” lineage occurred between the latest Eocene and the Late Oligocene. The split between the rainforest-dependent *S. swaini* and the three open forest/saxicolous forms, *S. moritzi*, *S. wyberba* and *S. kateae*, dates to around 34–31 mya. The split amongst the saxicolous forms is more recent, 27–25 mya. The previous calibration has been used to maintain consistency between datasets. However, the dates given should be treated tentatively as cytochrome *b* is likely to be saturated at deeper divergences. Nonetheless, these dates do highlight the antiquity of the speciation events within this group.

By considering the historical geomorphology of the Clarence–Moreton Basin and the New England Block (the geological units which underlie the distributions of the species comprising the “*S. swaini*” lineage) it is possible to gain insights into the current distribution and diversification of the “*S. swaini*” lineage.

The southern portion of the Clarence–Moreton Basin is largely shaped by the erosive processes of the Clarence River (from 80 mya; late Cretaceous) which captured the streams running off the New England Block and cut a series of deep gorges at the base of the Dividing Range. These coalesced to form the Great Escarpment (Haworth & Ollier, 1992). It also features the Tweed, Main Range and Focal Peak Shield Volcanoes (Late Oligocene to Early Miocene, dated at 23.5–20.5 mya, 25–22 mya and 25.5–23.2 mya respectively; Ewart *et al.*, 1987; Willmott, 2004). This landscape, with its diverse topography and abundant rock, provided a canvas for divergence and subsequent speciation in the “*S. swaini*” lineage.

Climate change during the last 65 million years has alternated through three warm, wet intervals (Late Palaeocene to Middle Eocene, Early Miocene and possibly Early Pliocene) and cool, dry periods between; arguments for speciation in this period have largely concluded that there were periods of diversification through range expansion during the warm periods, and phases of extinction or range contraction during the cool periods (Greenwood & Christophel, 2005).

Hypothesized time of divergence in the “*S. swaini*” lineage coincides with the latest Eocene–Early Miocene cool phase; a period with cooler, drier vegetation types and diminished diversity within rainforest communities (Greenwood & Christophel, 2005). Despite a short-lived return to warm-wet conditions in the Early Miocene, climate deterioration continued. The widespread aseasonal wet biome (rainforest and wet heath) contracted, giving way to xerophytic com-

munities dominated by eucalypts, acacias and casuarinas (Galloway & Kemp, 1981) and there were rapid radiations in sclerophyll taxa (25–10 mya) associated with ecological and geographical expansions (Crisp *et al.*, 2004).

Past climate changes have severely affected rainforest communities. The rainforests of southeastern Australia were increasingly “... restricted to edaphically or topographically wetter pockets in the regional vegetational mosaic” (Greenwood & Christophel, 2005). These sheltered areas were well insulated from the effects of fire (Adam, 1992) and were crucial to the survival of rainforest taxa during arid times. Mount Warning, the Dorrigo–Ebor Plateau and the Macleay Gorges have been identified as important in this respect (Floyd, 1990).

We hypothesize that past arid cycles have had severe consequences for ancestral leaf-tails by attenuating populations, eliminating contact zones between populations and preventing gene flow. The gorges associated with the Clarence River (which antedate the initial divergence within the “*S. swaini*” lineage) and the Tweed, Main Range and Focal Peak volcanoes (which developed between the initial isolation of *S. swaini* from the ancestor of the saxicolous lineage, and the speciation of the three saxicolous taxa) were important refugia through dry times and continued to drive the mechanisms for allopatric divergence. The volcanic peaks were significant from the Early/Mid Miocene onwards, by which time large areas of lowland rainforest had contracted out of existence. While some populations remained rainforest-dependent and changed little over time, others became saxicolous and expanded through dry, rocky habitats. Deep rock crevices offered refuge against a generally inimical climate. The Clarence Valley, present since the Cretaceous, and without such crevice-based microhabitats on an alluvial plain, may have acted as a barrier to leaf-tail dispersal throughout, and subsequent to, the period of their speciation.

The leaf-tail populations isolated in the elevated, subtropical rainforests that developed on the Tweed, Main Range and Focal Peak Volcanoes ( $27^{\circ}53'–28^{\circ}48'S$ ) gave rise to *S. swaini*, a taxon with a continuous rainforest ancestry (the basal position of this species in the southern lineage on our phylogeny (see Fig. 1) and its morphological similarities to *S. cornutus*, a rainforest obligate from NEQ, may provide insights into the ancestral form to the “*S. swaini*” lineage). The remaining taxa, *S. moritzi* n.sp., *S. kateae* n.sp. and *S. wyberba*, are likely to have evolved in small isolates of dry rainforest (a depauperate version of the subtropical form; Adam, 1987) that persisted as fragmented remnants on the rocky slopes of gorges and escarpments. The small size of these habitats, coupled with the drier conditions during changed climatic regimes, created selection pressures that favoured occupation of rocky habitats (Fig. 14A,B) which were more insulated from environmental change. This, in turn, initiated the morphological shift to smaller body size and the habitat shift from trees to rocks that characterize these species.

Rock-dwelling populations probably persisted, even where remnant rainforests contracted out of existence. Once rock habitats had been invaded, opportunities were created for range expansions by *S. moritzi* n.sp. and *S. wyberba*. These taxa had access to the extensive gorges and rock outcrops of the New England Block. In some situations, geographically proximate populations of *S. moritzi* n.sp. occur in both rock (in dry forests), and rainforest habitats (e.g., near Coffs

Harbour). This, most likely represents a secondary shift back to the latter. The occurrence of *S. salebrosus* in rainforests and on rock escarpments does indicate the potential for the hypothesized shift between rainforest and rock habitats.

In contrast to the hypothesized range expansions of *S. wyberba* and *S. moritzi* n.sp., *Saltuarius kateae* n.sp. remains narrowly restricted and may be confined to sandstone escarpments north of Grafton. Its distribution is disjunct from the extensive rock habitats of the New England Block, broken by the main channel of the Clarence River and its broad alluvial plains. The significance of the dry Clarence Valley, with its northwest–southeast orientation, as a major barrier restricting the movements of both plants (Floyd, 1990) and animals (land snails, J. Stanisic pers. comm.; hexathelid spiders, R. Raven pers. comm.) is clearly recognized. Yet, prior to 27–25 mya (Late Oligocene) the dry forest/saxicolous leaf-tails (*S. moritzi* n.sp., *S. kateae* n.sp. and *S. wyberba*) maintained genetic exchange across this barrier. This may have been facilitated by a series of ranges from south and west of the Clarence River (near where the town of Jackadgery now stands, 29°35'S 152°34'E) running north and east to Mt Marsh (29°20'S 152°51'E). As aridity became more pronounced during the Late Tertiary and Quaternary, moist forest communities in the Clarence Valley gave way to open forests thus enhancing the river's significance as a biogeographic barrier. In the absence of robust phylogenies, it is not possible to speculate when this region became a significant barrier to the aforementioned invertebrate groups.

While there is little sequence divergence within either *S. swaini* (except for the Brindle Ck population, Fig. 1) or *S. kateae* n.sp., there are deep splits within the other taxa that coincide with geography, suggesting relatively ancient fragmentation events. There are two main lineages within *Saltuarius moritzi*: lineage A generally occurs at altitudes below 1000 m, lineage B generally at higher elevations. The divergence between lineages dates between 19.7–11.4 mya and suggests habitat fragmentation tied to the Miocene climate changes together with limited subsequent exchange of individuals between sites.

Within *S. wyberba*, the Gibralter Range population showed a high level of sequence divergence among individuals, with one specimen differing by 7.32% from the others on the same outcrop. This individual (AM R164153) was consistent in morphology and colour pattern with other specimens (AM R164152, QM J83586–87, AM R164155, AM R164157) from this site. This degree of sequence divergence within a site suggests either a long period of habitation of the immediate region, allowing mitochondrial sequence divergence to occur *in situ*, or secondary contact of two lineages of *S. wyberba*. *Saltuarius wyberba* and *S. moritzi* n.sp. are narrowly separated in the area east of Glen Innes, with no obvious barriers to movement, and a possible zone of contact may exist here. The proximity of the Queen Mary Falls *S. wyberba* population (on rocks/open forest) to the *S. swaini* populations (on trees/primary rainforest) of Main Range is unlikely to result in any genetic exchange as the two taxa are clearly partitioned by niche preference.

In the above overview of the distribution of the “*S. swaini*” lineage, the Clarence River is discussed in detail because of its previously-identified significance as a biogeographic barrier and importance in shaping the landscape in ways that were conducive to leaf-tail speciation. However, the significance of other lesser coastal river systems (Bellinger,

Macleay, Hastings and Manning Rivers) and the erosive processes that shaped them should not be overlooked—these all have a role in forming a landscape that could favour or restrict dispersal of lizards constrained by rainforest or rock crevice habitats. Seemingly small geographic features, like the Henry River Valley (an upper tributary of the Mann River separating *S. wyberba* from *S. moritzi* n.sp.), east of Glen Innes may have presented barriers to dispersal at population and species level. Nix (1991) notes that a “sea” of warm air at lower elevations within a valley can be as effective as an ocean barrier in blocking the movement of mesotherm flora and fauna.

We have identified the Late Eocene (34 mya)–Late Oligocene (25 mya) as an important period for genetic divergence of *Saltuarius* species in temperate southeastern Australia. Similar, though slightly older, dates (38–31 mya) apply to the genetic divergence seen amongst *Phyllurus* spp. on the Mackay Coast in mid-eastern Queensland (Couper *et al.*, 2000). However, phylogeographic studies show that the Quaternary was also important in shaping the current genetic signatures of leaf-tailed geckos from northeastern and mid-eastern Queensland (Schneider *et al.*, 1998 [*S. cornutus*]; Stuart-Fox *et al.*, 2001 [*Phyllurus ossa*]). Processes driven by Quaternary climate changes (during the last 1.8 million years) were “... responsible for the most recent sifting of the rainforest biota” (Adam, 1992).

**Conservation.** The current study provides high resolution data on species and phylogeographic diversity which is applicable to a process-oriented approach to conservation. Such an approach is discussed by Moritz and McDonald (2005) who state “The overall goal of a conservation strategy should be to protect the processes, both ecological and evolutionary, that sustain diversity at the ecosystem, species, and genetic levels”. In determining conservation priorities for the “*S. swaini*” lineage, it is clear that three of the four species involved (*S. swaini*, *S. moritzi* n.sp., and *S. wyberba*, especially the latter two) also include genetically divergent populations that should be viewed as separate entities for land management issues (see phylogeny, Fig. 1). These reflect genetic isolation stemming from past climate change. All three species, and the divergent populations within, are present in existing reserve systems. *Saltuarius wyberba* and some populations of *S. moritzi* n.sp. are closely associated with exposed rock outcrops, gorges and escarpments, while *S. swaini* is restricted to rainforests that blanket ancient volcanic peaks. These landscapes, largely selected for their scenic values (Fig. 14A,B), feature prominently in national parks and nature reserves. Additionally, these species have populations within state forests where access is restricted. The impacts of selective timber harvesting in forestry reserves are likely to be less severe where the geckos utilize a rock substrate. Tree dwelling populations are likely to have a better chance of recovery where selected harvests leave essential sheltering sites intact (i.e. living and dead trees with hollows). Clear-felling operations that remove these essential components of the habitat are likely to be of concern.

Two species, *S. wyberba* and *S. moritzi* n.sp. may occur widely on private land. As many of these populations are associated with rock outcropping, they are probably largely protected from the direct impacts of grazing. The effects of fire may be of greater concern. Duncan (2005), in assessing the impact of wildfire on terrestrial mollusc populations

stressed the importance of rock for “maintaining long-term species distribution within a range”. Fissures between rocks provide a vertical retreat to cool, moist environments allowing land snails to escape from the heat of fire. Survival following fires was skewed towards juvenile size classes, probably because smaller individuals have the ability to penetrate the substrate more deeply. Many of the rock outcrops supporting leaf-tailed gecko populations are massive, and in these situations fire may only have peripheral affects (leaf-tails living in surface retreats, beneath thin, exfoliating slabs may perish). Yet, fire may alter population structure in smaller rock piles that exist as outliers from larger outcrops. A loss of adult-sized individuals from a population will diminish reproductive success in subsequent seasons.

*Saltuarius kateae* n.sp. is currently known from two localities, Wyans Creek and Mt Marsh. The former locality is on private land, the latter within Mt Neville Nature Reserve (a large portion of Mount Marsh State Forest (60%) came under the control of the NSW Department of Environment and Conservation on 1 Jan., 1999. The southeast portion is now Banyabba Nature Reserve; the northeastern portion is now Mt Neville Nature Reserve—Guy Hodgson, Dept. of Environment and Conservation, Parks and Wildlife Division, NSW, pers. comm.). This species has the smallest distribution within the “*S. swaini*” lineage, with a range of 0.25° of latitude (*S. swaini* spans 1°, *S. wyberba* < 1.5° and *S. moritzi* n.sp. < 2.5°). The genetic samples used in our analyses came from a single population and showed no divergence. In view of the narrow range of this species, there is probably limited genetic divergence between the Wyans Creek and Mt Marsh populations. The Wyans Creek population is associated with sandstone escarpments and these formations (Kangaroo Creek Sandstones) are well represented in the Banyabba and Mt Neville Nature Reserves (Mick Andren, Dept. Environment and Conservation, NSW, pers. comm.). The predicted presence of *S. kateae* n.sp. in Banyabba Nature Reserve still requires confirmation.

The potential impacts of global warming continue to ring alarm bells in many quarters and there is little doubt that montane communities will be hit hard by human-induced climate change. Rising temperatures promote upward shifts of both flora and fauna (Montaigne, 2004; Kluger, 2006; Grabherr *et al.*, 1994), yet there are tight constraints on these altitudinal movements. A limited dispersal ability equates to a higher extinction risk (Thomas *et al.*, 2004). Williams *et al.* (2003) assessed the impact of climate change on endemic vertebrates living in mountain rainforests of northeastern Queensland. Using bioclimatic models of spatial distribution, they predict high, nonlinear extinction rates due to loss of core environments, with rapid increases in losses beyond an average temperature increase of 2°C. Projections by CSIRO (2001), relative to 1990, predict average temperature increases of 0.4–2.0°C by 2030 and 1.0–6.0°C by 2070 (Hughes, 2003). These predictions present a bleak outlook. Sadlier *et al.* (2005) have expressed concern for the montane rainforests of mid-eastern Queensland (Eungella, Clarke Range), where two skinks, *Saproscincus eungellensis* and *Eulamprus luteolateralis* have narrow altitudinal limits; the former restricted to elevations above 700 m, the latter above 900 m. Rising temperatures are likely to elevate the direct risk of extinction for both species and may also benefit the plant pathogen, *Phytophthora cinnamomi*, that is present in these forests, creating indirect effects on habitat suitability.

To assess the impacts of global warming on the members of “*S. swaini*” lineage, it is important to consider the phylogeography (see above) of this group. In discussing how ecological communities adjust to unforeseen change, Leigh and Rubinoff (2005) state, “Populations presumably recover best from disturbances their ancestors have frequently encountered.” This assumption would infer that the rock-dwelling species, *S. moritzi* n.sp. (some populations), *S. kateae* n.sp. and *S. wyberba*, that have experienced greater selection pressures in response to past climatic events are more likely to adjust to rising temperatures than *S. swaini*. Further, large outcrops of deeply cracked rocks provide a stable habitat which provides considerable buffering from thermal extremes. *Saltuarius swaini*, on the other hand, lives in a habitat that will progressively degrade with rising temperatures. Its evolutionary history, involving a continuous rainforest ancestry, may reduce its ability to adapt during rapid climate change. Ecological stasis could leave this species ill equipped to cope with global warming and significantly elevate its extinction risk.

In their assessment of the impact of global warming on endemic vertebrates in the Wet Tropics, Williams *et al.* (2003) concluded that a temperature rise of 5°C would cause total habitat loss for 88% of species and, for the remaining 12% of species, a reduction of core habitat area to an average of 3% of its former area. A temperature increase of 7°C would cause total loss of core habitat for all species. In this study, *S. cornutus*, the northern, ecological equivalent of *S. swaini* (both rainforest endemics with broad altitudinal ranges), was one of the last species to lose its entire core habitat (Williams, pers. comm.). Extrapolating from this study, and allowing that temperature increases predicted by CSIRO run closer to maximum predictions, then *S. swaini* could be drastically reduced to a small remnant population as early as 2070. This, of course, is the worst case scenario and many other rainforest vertebrates from southeastern Queensland and NSW will decline more rapidly than *S. swaini* and some, with narrow altitudinal distributions, could face extinction as early as 2030. An extrapolation of this kind does not take into account the ability of individuals of a species to behaviourally buffer against thermal extremes, nor does it allow that temperature increases may affect rainforests adapted to different climates in different ways. Yet, the rainforests of eastern Australia, both northern and southern, have had similar responses to past climatic events (Greenwood & Christophel, 2005; Martin, 1987, 1997).

A further factor potentially impacting on survival through environmental change is the genetic diversity of populations. With the exception of the sample of *S. wyberba* from Gibralter Range (AM R164153) and the sample of *S. moritzi* n.sp. from Bruxner Park (AM R164146), we found very low levels of genetic difference among individuals within samples, and in many cases, particularly within *S. swaini*, very limited genetic variation between localities. These apparent low levels of genetic diversity may reflect limited potential to survive severe population decreases, an effect that is likely to be most marked for *S. swaini* and *S. kateae* n.sp.

**Future directions.** The discriminate functions analyses (DFAs) point to unresolved issues that can only be clarified with further fieldwork, coupled with genetic and morphological studies. Most of the individuals that were incorrectly identified by the DFAs can be considered as true misidenti-

ifications, but there are three individuals (from Blady Grass Creek QM J72343, Oakwood AM R143592, and Guyra AM R43870, the first genetically typed as *S. moritzi* n.sp., the second geographically within 30 km of the previous locality, the third more distant, but geographically closest to this locality) which form a geographic cluster. All three were presumed to represent *S. moritzi* n.sp. based on geography and proximity to a single individual genetically typed as this species, but were identified by the morphological analysis as *S. wyberba*. Given the paucity of material from this region and the lack of congruence between the genetic and morphological data for QM J72343, we consider that the identity of *Saltuarius* from this region should be treated as indeterminate pending the collection of larger samples. The Blady Grass Creek, Oakwood and Guyra specimens are all geographically proximate to the presumed break between the distributions of *S. moritzi* n.sp. and *S. wyberba*, raising the possibility of existence of a hybrid zone.

**ACKNOWLEDGMENTS.** The authors wish to thank the Australian and Queensland Museums for financially supporting this project. We are especially grateful to Chris Schneider (Boston University) for his ongoing support and access to his unpublished sequence data; Harry Hines (QPWS) and Conrad Hoskin (University of Queensland) for field observations, tissue samples and ongoing discussions on leaf-tail distributions; Fred Kraus (Bishop Museum / Hawaii) and Rod Hobson (Qld Parks and Wildlife Service) for their assistance, and excellent company, in the field; Gary Stephenson for pointing us to the Glenreagh collection site; Mick Andreu and Guy Hodgson (Dept of Environment and Conservation, NSW) for information on land tenure and topography of the Mt Marsh area; Steve Williams and John Winter for their thoughts on global warming; Tony Ewart for discussions on underlying geology, and Amy and Hannah Couper for allowing their holiday destinations to be within striking range of leaf-tailed gecko habitats. All specimens collected in New South Wales for this project were collected under New South Wales National Parks and Wildlife Service Scientific Authority (A1397) license number S10807 to the Australian Museum, and under Australian Museum Animal Research Authority Project No. 04–12 to Principal Investigator Ross A. Sadlier.

## References

Adam, P., 1987. *New South Wales Rainforests the Nomination for the World Heritage List*. Sydney: National Parks and Wildlife Service of N.S.W.

Adam, P., 1992. *Australian Rainforests*. Oxford: Clarendon Press.

Anonymous, 1975. *Australian 1:250,000 Map Series Gazetteer prepared by the Division of National Mapping, Department of Minerals and Energy, Canberra, A.C.T.* Canberra: Australian Government Publishing Service.

Bauer, A.M., 1990. Phylogenetic Systematics and Biogeography of the Carphodactylini (Reptilia: Gekkonidae). *Bonner Zoologische Monographien* 30: 1–217.

Bauer, A.M., & T. Lamb, 2001. A reconsideration of the systematic status of *Rhoptropus bradfieldi diporus* Haacke 1965. *African Journal of Zoology* 50: 71–78.

Bauer, A.M., T. Lamb & W.R. Branch, 2002. A revision of *Pachydactylus scutatus* (Reptilia: Squamata: Gekkonidae) with the description of a new species from northern Namibia. *Proceedings of the Californian Academy of Sciences* 53: 23–36.

Carranza, S., E.N. Arnold, J.A. Mateo & P. Geniez, 2002. Relationships and evolution of the North African geckos, *Geckonia* and *Tarentola* (Reptilia: Gekkonidae), based on mitochondrial and nuclear DNA sequences. *Molecular Phylogenetics and Evolution* 23(2): 244–256.  
[http://dx.doi.org/10.1016/S1055-7903\(02\)00024-6](http://dx.doi.org/10.1016/S1055-7903(02)00024-6)

Cogger, H.G., 1983. *Reptiles and Amphibians of Australia*. Third edition. Sydney: A.H. & A.W. Reed.

Cogger, H.G., 1986. *Reptiles and Amphibians of Australia*. Fourth edition. Sydney: Reed Books.

Cogger, H.G., 1992. *Reptiles and Amphibians of Australia*. Fifth edition. Sydney: Reed Books.

Couper, P.J., J.A. Covacevich & C. Moritz, 1993. A review of the leaf-tailed Geckos endemic to eastern Australia: a new genus, four new species, and other new data. *Memoirs of the Queensland Museum* 34: 95–124.

Couper, P.J., J.A. Covacevich & C. Moritz, 1994. Designation of the type species of *Saltuarius*, and other data on the genus. *Memoirs of the Queensland Museum* 35: 26.

Couper, P.J., C.J. Schneider & J.A. Covacevich, 1997. A new species of *Saltuarius* (Lacertilia: Gekkonidae) from granite-based, open forests of eastern Australia. *Memoirs of the Queensland Museum* 42: 91–96.

Couper, P.J., C.J. Schneider, C.J. Hoskin & J.A. Covacevich, 2000. Australian leaf-tailed geckos: phylogeny, a new genus, two new species and other new data. *Memoirs of the Queensland Museum* 45: 253–265.

Covacevich, J., 1975. A review of the genus *Phyllurus* (Lacertilia: Gekkonidae). *Memoirs of the Queensland Museum* 17: 293–303.

Cracraft, J., 1983. Species concepts and speciation analysis. *Current Ornithology* 1: 159–187.

Crisp, M., L. Cook & D. Steane, 2004. Radiation of the Australian flora: what can comparisons of molecular phylogenies across multiple taxa tell us about the evolution of diversity in present-day communities? *Philosophical Transactions of the Royal Society of London B* 359(1450): 1551–1571.  
<http://dx.doi.org/10.1098/rstb.2004.1528>

CSIRO, 2001. Climate change: projections for Australia (Internet document). Aspendale, Victoria: CSIRO Climate Impact Group.  
<http://www.cmar.csiro.au/e-print/open/projections2001.pdf>

Duncan, N., 2005. *Monitoring of Sensitive Mollusk Populations Following Low-intensity Wildfires in Old Growth Coniferous Forest*, final report to the Interagency Special Status Species Program, USDA Forest Service and USDI Bureau of Land Management (Portland, OR).  
[http://www.unc.edu/~keperez/Final%20Report\\_Monitoring%20of%20Mollusks%20Following%20Fire.pdf](http://www.unc.edu/~keperez/Final%20Report_Monitoring%20of%20Mollusks%20Following%20Fire.pdf) [11 May 2008]

Ewart, A., N.C. Stevens & J.A. Ross, 1987. The Tweed and Focal Peak Shield Volcanoes, southeast Queensland and Northeastern New South Wales. *Papers of the Department of Geology University of Queensland* 11: 1–82.

Floyd, A., 1990. *Australian rainforests in New South Wales*, volume 1. Chipping Norton, NSW: Surrey Beatty & Sons.

Galloway, R.W., & E.M. Kemp, 1981. Late Cainozoic environments in Australia. In *Ecological Biogeography of Australia. Monographie Biologicae*, volume 1, ed. A. Keast, pp. 51–80. The Hague: W. Junk.

Grabherr, G., M. Gottfried & H. Paull, 1994. Climate effects on mountain plants. *Nature* 369(6480): 448.  
<http://dx.doi.org/10.1038/369448a0>

Greenwood, D.R., & D.C. Christophel, 2005. The origins and Tertiary history of Australian “tropical” rainforests. In *Tropical Rainforests*, ed. E. Bermingham, C.W. Dick and C. Moritz, pp. 336–373. Chicago: University of Chicago Press.

Greer, A.E., 1989. *The Biology and Evolution of Australian Lizards*. Sydney: Surrey Beatty & Sons Pty Ltd.

Harris, D.J., 2002. Reassessment of comparative genetic distance in reptiles from the mitochondrial cytochrome b gene. *Herpetological Journal* 12: 85–86.

Harris, D.J., V. Batista, P. Lymberakis & M.A. Carretero, 2004. Complex estimates of evolutionary relationships in *Tarentola mauritanica* (Reptilia: Gekkonidae) derived from mitochondrial DNA sequences. *Molecular Phylogenetics and Evolution* 30(3): 855–859.  
[http://dx.doi.org/10.1016/S1055-7903\(03\)00260-4](http://dx.doi.org/10.1016/S1055-7903(03)00260-4)

Haworth, R.J., & C.D. Ollier, 1992. Continental rifting and drainage reversal: The Clarence River of Eastern Australia. *Earth Surface Processes and Landforms* 17(4): 387–397.  
<http://dx.doi.org/10.1002/esp.3290170408>

Hoskin, C.J., P.J. Couper & C.J. Schneider, 2003. A new species of *Phyllurus* (Lacertilia: Gekkonidae) and a revised phylogeny and key for the Australian leaf-tailed geckos. *Australian Journal of Zoology* 51(2): 153–164.  
<http://dx.doi.org/10.1071/Z002072>

Hughes, L., 2003. Climate change and Australia: trends, projections and impacts. *Austral Ecology* 28(4): 423–443.  
<http://dx.doi.org/10.1046/j.1442-9993.2003.01300.x>

Jesus, J., A. Brehm & D.J. Harris, 2002. Relationships of *Tarentola* (Reptilia: Gekkonidae) from the Cape Verde Islands estimated from DNA sequence data. *Amphibia-Reptilia* 23: 47–54.  
<http://dx.doi.org/10.1163/156853802320877618>

Jesus, J., A. Brehm & D.J. Harris, 2006. Phylogenetic relationships of *Lygodactylus* geckos from the Gulf of Guinea islands: rapid rates of mitochondrial DNA sequence evolution? *Herpetological Journal* 16: 291–295.

Kluger, J. 2006. The tipping point. *Time* April, no. 13: 20–28.

Lamb, T., & A.M. Bauer, 2000. Relationships of the *Pachydactylus rugosus* group of geckos (Reptilia: Squamata: Gekkonidae). *African Zoology* 35: 55–67.

Lamb, T., & A.M. Bauer, 2001. Mitochondrial phylogeny of Namib Day Geckos (*Rhoptropus*) based on cytochrome b and 16S rRNA sequences. *Copeia* 2001(3): 775–780.  
[http://dx.doi.org/10.1643/0045-8511\(2001\)001\[0775:MPONDG\]2.0.CO;2](http://dx.doi.org/10.1643/0045-8511(2001)001[0775:MPONDG]2.0.CO;2)

Leigh, E.G., & I. Rubinoff, 2005. Understanding and conserving tropical diversity: perspectives from Barro Colorado Island. In *Tropical Rainforests*, ed. E. Bermingham, C.W. Dick and C. Moritz, pp. 223–250. Chicago: University of Chicago Press.

Martin, H.A., 1987. Cainozoic history of the vegetation and climate of the Lachlan River Region, New South Wales. *Proceedings of the Linnean Society of N.S.W.* 109: 213–251.

Martin, H.A., 1997. The stratigraphic palynology of bores along the Darling River, downstream from Bourke, New South Wales. *Proceedings of the Linnean Society of N.S.W.* 118: 51–67.

Montaigne, F., 2004. Ecosigns: No room to run. *National Geographic* 206(3): 34–55.

Moritz, C.J., & K.R. McDonald, 2005. Evolutionary approaches to the conservation of tropical rainforest vertebrates. In *Tropical Rainforests*, ed. E. Bermingham, C.W. Dick and C. Moritz, pp. 532–557, Chicago: University of Chicago Press.

NSW National Parks and Wildlife Service, 1994. *Fauna of the North-east NSW Forests*. North East Forests Biodiversity Report no. 3. Sydney: NSW National Parks and Wildlife Service.

Nix, H.A., 1991. Biogeography: patterns and process. In *Rainforest Animals: Atlas of Vertebrates Endemic to Australia's Wet Tropics*, ed. H.A. Nix and M. Switzer, pp. 11–39. Canberra: Australian National Parks and Wildlife Service.

Ogilby, J.D., 1892. Descriptions of three new Australian lizards. *Records of the Australian Museum* 2(1): 6–11.  
<http://dx.doi.org/10.3853/j.0067-1975.2.1892.1180> [Link active from January 2009]

Posada, D., & K.A. Crandall, 1998. Modeltest: testing the model of DNA substitution. *Bioinformatics* 14(9): 817–818.  
<http://dx.doi.org/10.1093/bioinformatics/14.9.817>

Rambaut, A., 1996. *Se-A: Sequence Alignment Editor*. Version 2.0a11.  
<http://tree.bio.ed.ac.uk/software/seal/> [7 May 2008]

Ronquist, F., & J.P. Huelsenbeck, 2003. MRBAYES 3: Bayesian phylogenetic inference under mixed models. *Bioinformatics* 19: 1572–1574.  
<http://dx.doi.org/10.1093/bioinformatics/btg180>

Sadlier, R.A., P.J. Couper, D.J. Colgan, E. Vanderduys & E. Rickard, 2005. A new species of scincid lizard, *Saproscincus eungellensis*, from mid-eastern Queensland. *Memoirs of the Queensland Museum* 51: 559–571.

Schaltegger, U., T. Pettke, A. Audéat, E. Reusser & C. Heinrich, 2005. Magmatic-to-hydrothermal crystallization in the W-Sn mineralised Mole Granite (NSW, Australia). Part 1: Crystallization of zircon and REE-phosphates over three million years—a geochemical and U-Pb fgeochronological study. *Chemical Geology* 220(3-4): 215–235.  
<http://dx.doi.org/10.1016/j.chemgeo.2005.02.018>

Schneider, C.J., M. Cunningham & C. Moritz, 1998. Comparative phylogeography and the history of endemic vertebrates in the Wet Tropics rainforests of Australia. *Molecular Ecology* 7(4): 487–498.  
<http://dx.doi.org/10.1046/j.1365-294x.1998.00334.x>

Stuart-Fox, D.M., C.J. Schneider, C. Moritz & P.J. Couper, 2001. Comparative phylogeography of three rainforest-restricted lizards from mid-eastern Queensland. *Australian Journal of Zoology* 49(2): 119–127.  
<http://dx.doi.org/10.1071/Z000092>

Thomas, C.D., A. Cameron, R.E. Green, M. Bakkenes, L.J. Beaumont, Y.C. Collingham, B.F.N. Erasmus, M. Ferreira De Siqueira, A. Grainger, L. Hannah, L. Hughes, B. Huntley, A.S. Van Jaarsveld, G.F. Midgley, L. Miles, M.A. Ortega-Huerta, A. Townsend Peterson, O.L. Phillips & S.E. Williams, 2004. Extinction risk from climate change. *Nature* 427(6970): 145–148.  
<http://dx.doi.org/10.1038/nature02121>

Thorpe, R.S., 1975. Quantitative handling of characters useful in snake systematics with particular reference to intraspecific variation in the Ringed Snake *Natrix natrix* (L.). *Biological Journal of the Linnean Society* 7(1): 27–43.  
<http://dx.doi.org/10.1111/j.1095-8312.1975.tb00732.x>

Thorpe, R.S., 1980. A comparative study of ordination techniques in numerical taxonomy in relation to racial variation in the Ringed Snake *Natrix natrix* (L.). *Biological Journal of the Linnean Society* 13(1): 7–40.  
<http://dx.doi.org/10.1111/j.1095-8312.1980.tb00067.x>

Wells, R.W., & R.C. Wellington, 1985. A classification of the Amphibia and Reptilia of Australia. *Australian Journal of Herpetology* Supplementary series no. 1: 1–61.

White, J., 1790. *Journal of a Voyage to new South Wales with Sixty-five Plates on Non descript Animals, Birds, Lizards, Serpents, curious Cones of Trees and other Natural Productions*. Piccadilly: J. Debrett.

Williams, S.E., E.E. Bolitho & S. Fox, 2003. Climate change in Australian tropical rainforests: an impending environmental catastrophe. *Proceedings of the Royal Society of London B* 270(1527): 1887–1892.  
<http://dx.doi.org/10.1098/rspb.2003.2464>

Willmott, W., 2004.  *Rocks and Landscapes of the National Parks of Southern Queensland*. Brisbane: Geological Society of Australia, Queensland Division.

Wilson, S.K., & D.G. Knowles, 1988. *Australia's Reptiles: A Photographic Reference to the Terrestrial Reptiles of Australia*. Sydney: Collins Publishers Australia.

Zar, J.H., 1974. *Biostatistical Analysis*. Englewood Cliffs: Prentice-Hall.

Manuscript submitted 06 July 2007, revised 19 March 2008, and accepted 31 March 2008.

Associate Editor: S. Ingleby

Appendix 1. List of localities, museum registration numbers, Genbank accession numbers and identifications for specimens used in the genetic analyses.

locality	museum registration	Genbank Accession no.	identification
Chaelundi SF, northern NSW	AM R141964-5	EU625300	<i>S. moritzi</i> n.sp.
Bruxner Park, nr Coffs Harbour NSW	AM R160420	EU625301	<i>S. moritzi</i> n.sp.
Blady Grass Ck, nr Glen Innes, NSW	QM J72343	EU625302	<i>S. moritzi</i> n.sp.
O'Sullivans Gap, Bulahdelah, NSW	AM R163000	EU625303	<i>S. moritzi</i> n.sp.
O'Sullivans Gap, Bulahdelah, NSW	AM R163001	EU625304	<i>S. moritzi</i> n.sp.
Ebor Falls, New England, NSW	AM R163003	EU625305	<i>S. moritzi</i> n.sp.
Ebor Falls, New England, NSW	QM J83593	EU625306	<i>S. moritzi</i> n.sp.
Ebor Falls, New England, NSW	AM R163005	EU625307	<i>S. moritzi</i> n.sp.
Blue Hole, Armidale, NSW	QM J83588	EU625308	<i>S. moritzi</i> n.sp.
Blue Hole, Armidale, NSW	QM J83589	EU625309	<i>S. moritzi</i> n.sp.
Sherwood NR, Glenreagh, NSW	AM R158973	EU625310	<i>S. moritzi</i> n.sp.
Sherwood NR, Glenreagh, NSW	QM J83591	EU625311	<i>S. moritzi</i> n.sp.
Bruxner Park, nr Coffs Harbour NSW	AM R158945	EU625312	<i>S. moritzi</i> n.sp.
Bruxner Park, nr Coffs Harbour NSW	QM J83592	EU625313	<i>S. moritzi</i> n.sp.
Bruxner Park, nr Coffs Harbour NSW	AM R164146	EU625314	<i>S. moritzi</i> n.sp.
Comboyne Plateau, Boorgana NR, NSW	AM R158991	EU625315	<i>S. moritzi</i> n.sp.
Werrikimbee NP, NSW	no voucher	EU625316	<i>S. moritzi</i> n.sp.
Grange SF, Dorrigo, NSW	AM R141966	EU625317	<i>S. moritzi</i> n.sp.
Main Range NP, SEQ	no voucher	EU625318	<i>S. swaini</i>
Main Range NP, SEQ	no voucher	EU625319	<i>S. swaini</i>
Mt Mitchell, Main Range NP, SEQ	QM J80792	EU625320	<i>S. swaini</i>
Mt Cordeaux, Main Range NP, SEQ	QM J80793	EU625321	<i>S. swaini</i>
Lamington NP, SEQ	QM J51640	EU625322	<i>S. swaini</i>
Mt Tamborine, SEQ	QM J51095	EU625323	<i>S. swaini</i>
Mt Warning, NE NSW	QM J83594	EU625324	<i>S. swaini</i>
Cambridge Plateau, NSW	AM R158999	EU625325	<i>S. swaini</i>
Brindle Ck, Border Ranges NP, NSW	AM R158987	EU625326	<i>S. swaini</i>
Wyans Creek, Richmond Range, NSW	QM J83584	EU625327	<i>S. kateae</i> n.sp.
Wyans Creek, Richmond Range, NSW	QM J83585	EU625328	<i>S. kateae</i> n.sp.
Wyans Creek, Richmond Range, NSW	QM J83583	EU625329	<i>S. kateae</i> n.sp.
Wyans Creek, Richmond Range, NSW	AM R164166	EU625330	<i>S. kateae</i> n.sp.
Spirabo Forest Way, NE NSW	no voucher	EU625331	<i>S. wyberba</i>
Queen Mary Falls, Main Range NP, SEQ	QM J80794	EU625332	<i>S. wyberba</i>
Queen Mary Falls, Main Range NP, SEQ	QM J80795	EU625333	<i>S. wyberba</i>
Queen Mary Falls, Main Range NP, SEQ	QM J80796	EU625334	<i>S. wyberba</i>
Gibralter Range, New England, NSW	AM R164153	EU625335	<i>S. wyberba</i>
Gibralter Range, New England, NSW	QM J83586	EU625336	<i>S. wyberba</i>
Gibralter Range, New England, NSW	AM R164157	EU625337	<i>S. wyberba</i>
Girraween NP, SEQ	AM R157130	EU625338	<i>S. wyberba</i>
Girraween NP, SEQ	QM J51633	EU625339	<i>S. wyberba</i>
south of the Black Mountain corridor, north QLD	no voucher	AF109502	<i>S. cornutus</i> 1
north of Black Mountain corridor, north QLD	no voucher	AF109487	<i>S. cornutus</i> 2
Big Tableland, north QLD	no voucher	EU625340	<i>S. cornutus</i> BT
Blackdown Tableland, QLD	QM J51091	EU625341	<i>S. salebrosus</i>
Bulburin SF, QLD	QM J51090	EU625342	<i>S. salebrosus</i>

## Appendix 2. Allocation of specimens for multivariate analyses (see materials and methods).

**1 Specimens identified (from within 30 km of genetic sample)**

## Females:

*Saltuarius kateae* n.sp.: AM R164163, AM R164166, AM R139790, QM J83583–85  
*Saltuarius moritzi* n.sp.: AM R8253, AM R16905, AM R16989, AM R69866, AM R71372, AM R101338, AM R143590, AM R143592, AM R158945, AM R158973, AM R158977, AM R163001, AM R163006, AM R163009, QM J9054, QM J83589, QM J83590–83591  
*Saltuarius swaini*: AM R116978, QM J2933–34, QM J4819, QM J5649, QM J8183, QM J8359, QM J8646, QM J51095  
*Saltuarius wyberba*: AM R164152, QM J35401, QM J50345, QM J61543–45, QM J80795

## Males:

*Saltuarius moritzi* n.sp.: AM R6247, AM R6915, AM R43871, AM R43873–75, AM R59313, AM R71373, AM R103031, AM R106749, AM R141964–65, AM R153478, AM R158974, AM R158978, AM R158990, AM R160420–21, AM R163000, AM R163002–03, AM R163010, AM R163012, QM J72343, QM J83588, QM J83592, QM J83593.  
*Saltuarius swaini*: AM R2409, AM R11860, AM R97823, AM R98333, AM R130911, AM R158987, AM R158999, AM R160423, QM J2409, QM J3254, QM J4198, QM J4439, QM J5690, QM J10440, QM J51637–40, QM J54846, QM J80792–93, QM J83594.  
*Saltuarius wyberba*: AM R149768, AM R156806, AM R164153, AM R164157, QM J25374, QM J28648–49, QM J29116–17, QM J30420, QM J51093, QM J51633–36, QM J54847, QM J61539–42, QM J70465, QM J80794, QM J80796, QM J83586–87.

**2 Specimens treated as of unknown identity for the purposes of analyses (more than 30 km from a genetic sample or from sites where 30 km radii from different genetic taxa overlapped or no collection data available)**

## Females:

AM R6792, AM R43870, AM R150912—assumed to be *S. moritzi* n.sp. from locality or overall appearance.  
 AM R92122, QM J8099, QM J23937, QM J36116 (no data—excluded from species account): assumed to be *S. swaini* from locality or overall appearance.  
 QM J79753 (no data—excluded from species account) QM J79754, QM J79757: assumed to be *S. wyberba* from overall appearance.

## Males:

AM R164161: assumed to be *S. kateae* n.sp. from the locality.  
 AM R6284, QM J56894: assumed to be *S. moritzi* n.sp. from locality or overall appearance.  
 QM J8074, QM J51094: assumed to be *S. swaini* from morphology.  
 AM R110510, QM J53984, QM J79758: assumed to be *S. wyberba* from morphology.

**3 Specimens that were unable to be used in the analyses because of missing data, but fell within 30 km radii of genetic samples.**

## Females:

AM R43872: *S. moritzi* n.sp.  
 QM J148, QM J8861, QM J81611: *S. swaini*.  
 J27349: *S. wyberba*.

## Males:

AM R69867, AM R151753: *S. moritzi* n.sp.  
 QM J3215, QM J3313: *S. swaini*.  
 QM J30677: *S. wyberba*.

**4 Specimens that were not used in the analyses because of missing data, and were more than 30 km from genetic samples, or were from regions where different species' 30 km radii overlapped.**

## Females:

AM R150911: (excluded from species account): assumed to be *S. moritzi* n.sp. on morphology.  
 QM J47144 (no data—excluded from species account): assumed to be *S. moritzi* n.sp. on morphology.

**5 Unsexed specimens that were not used in the analyses (includes juveniles).**

AM R15412, AM R17008, AM R54071, AM R59314, AM R81921, AM R97670–72, AM R123490, AM R143591, AM R158946, AM R163005, AM R164146: *S. moritzi* n.sp.  
 QM J398, QM J1143, QM J5382, QM J5757, QM J10565, QM J12257: *S. swaini*.  
 AM R164155, QM J68108, QM J79755: *S. wyberba*.

**6 Specimen not included in analyses with missing data and unknown locality.**

## Male:

QM J79756: *S. wyberba*.

**7 Specimen not included in analyses because of uncertainty of locality data (see remarks *S. moritzi* n.sp.).**

AM R141966: assumed to be *S. moritzi* n.sp. on morphology.

# INSTRUCTIONS TO AUTHORS

Manuscripts must be submitted to The Editor. All manuscripts are refereed externally.

Only those manuscripts that meet the following requirements will be considered for publication. Large monographic works are considered for publication only when the subject matter aligns closely with the Museum's strategic objectives.

Submit manuscripts electronically and as one printed copy; images should be high resolution TIFFs (see below). Attach one summary file or cover sheet giving: the title; the name, address and contact details of each author; the author responsible for checking proofs; a suggested running-head of less than 40 character-spaces; and the number of figures, tables and appendices. Manuscripts must be complete when submitted.

Text files, tables and charts should be in Rich Text Format (RTF). Tables and figures should be numbered and referred to in numerical order in the text. Electronic copy is stripped and reconstructed during production, so authors should avoid excessive layout or textual embellishments; a single font should be used throughout (Times or Times New Roman are preferred); avoid using uncommon fonts.

All copy is manipulated within a Windows (not Mac) environment using Microsoft and Adobe software. The submitted printed copy of the manuscript should be derived directly from the electronic file that accompanies it.

Manuscripts should be prepared using recent issues as a guide. There should be a title (series titles should not be used), author(s) with their institutional and e-mail addresses, an abstract (should be intelligible by itself, informative not indicative), introduction (should open with a few lines for general, non-specialist readers), materials and methods, results (usually subdivided with primary, secondary and rarely tertiary-level headings), discussion, acknowledgments and references. If appropriate, an appendix may be added after references.

In the titles of zoological works the higher classification of the group dealt with should be indicated. Except for common abbreviations, definitions should be given in the materials and methods section. Sentences should not begin with abbreviations or numerals. Metric units must be used except when citing original specimen data. It is desirable to include geo-spatial coordinates; when reference is made to them, authors must ensure that their format precludes ambiguity, in particular, avoid formats that confuse arcminutes and arcseconds.

Label and specimen data should, as a minimum requirement, indicate where specimens are deposited. Original specimen data—especially that of type material—is preferred over interpreted data. If open to interpretation, cite original data between quotation marks or use “[sic]”.

Rules of the International Code of Zoological Nomenclature must be followed; authors must put a very strong case if a Recommendation is not followed. When new taxa are proposed in works having multiple authors, the identity of the author(s) responsible for the new name(s) and for satisfying the criteria of availability, should be made clear in accordance with Recommendations in Chapter XI of the Code. A scientific name with more than two authors is unwieldy and should be avoided. Keys are desirable; they must be dichotomous and not serially indented. Synonymies should be of the short form: taxon author, year, pages and figures. A period and en-dash must separate taxon and author except in the case of reference to the original

description. Proposed type material should be explicitly designated and, unless institutional procedure prohibits it, registered by number in an institutional collection.

Previously published illustrations will generally not be accepted. Extra costs resulting from colour production are charged to the author (AU\$1000 for 1–8 pp, AU\$2000 for 9–16 pp, etc.; these charges can be shared by authors of different papers that are printed consecutively). All images must (a) be rectangular or square and scalable to a width of 83 mm (one text column) or 172 mm (both text columns including gutter) and any depth up to 229 mm (the number of lines in a caption limits depth); (b) have lettering similar to 14 point, upper case, normal, Helvetica, in final print; (c) have no unnecessary white or black space; and (d) have vertical or horizontal scale bars, with the lengths given in the caption and with the thickness approximately equal to an upper case 14 point letter "I".

Digital images must be presented as TIFF, or as multilayered PSD files suitable for *Adobe Photoshop* version 5.0 or later. Halftone and colour images must be at a minimum resolution of 300 dpi at final size (at this resolution 2040 pixels = page width) and all labelling must be sharp (with *anti-aliased* active). Black and white line images (bitmaps) must be at a minimum resolution of 1200 dpi at final size (at this resolution, 8160 pixels = page width).

When reference is made to figures in the present work use Fig. or Figs, when in another work use fig. or figs; the same rule applies to the case of the word tables. Figures and tables should be numbered and referred to in numerical order in the text.

Authors should refer to recent issues of the *Records of the Australian Museum* to determine the correct format for listing references and to *The Chicago Manual of Style* to resolve other matters of style. Insert hyperlinks in the Reference section if they are known—use *digital object identifiers* (doi) if available (see [www.doi.org](http://www.doi.org) and [www.crossref.org](http://www.crossref.org)).

Certain anthropological manuscripts (both text and images) may deal with culturally sensitive material. Responsibility rests with authors to ensure that approvals from the appropriate person or persons have been obtained prior to submission of the manuscript.

Stratigraphic practice should follow the *International Stratigraphic Guide* (second edition) and *Field Geologist's Guide to Lithostratigraphic Nomenclature in Australia*.

The Editor and Publisher reserve the right to modify manuscripts to improve communication between author and reader. Essential corrections only may be made to final proofs. No corrections can be accepted less than four weeks prior to publication without cost to the author(s). All proofs should be returned as soon as possible. Fifty reprints may be ordered, the fee is AU\$10.00 times the number of printed pages.

All authors, or the Corresponding Author on their behalf, must sign a *Licence to Publish* when a manuscript is submitted and certify that the research described has adhered to the Australian Museum's *Guidelines for Research Practice*—or those of their home institution providing they cover the same issues, especially with respect to authorship and acknowledgment. While under consideration, a manuscript may not be submitted elsewhere.

More information and examples are available at our website:

[www.australianmuseum.net.au/publications/](http://www.australianmuseum.net.au/publications/)

## YOUR SUPPORT MAKES A DIFFERENCE

The Australian Museum strives to inspire the exploration of nature and cultures. We would like to acknowledge the benefactors and corporate partners who support us in achieving this vision.

These generous individuals contribute to scientific research, education programs and public programs, and assist in the acquisition of items that enrich our collections. We would especially like to acknowledge those who generously leave a gift to the Australian Museum in their will—a lasting way to benefit generations to come.

If you would like to find how your support can make a difference to the important work of the Australian Museum, please contact the Development Branch on +612 9320 6216 or e-mail [development@austmus.gov.au](mailto:development@austmus.gov.au). Donations to the Australian Museum and its Foundation are tax deductible.

### PRINCIPAL PARTNERS

Australian Museum Members  
Coral Reef and Marine Science Foundation  
JCDecaux  
Lizard Island Reef Research Foundation  
National Geographic Channel  
Rio Tinto  
Sydney Grammar School

### AUSTRALIAN MUSEUM FOUNDATION

Founding Donors  
Atanaskovic Hartnell  
Lucy Turnbull  
  
President's Circle  
ANZ Bank  
Anita and Luca Belgiorno-Nettis  
Susan Conde  
Ernst & Young  
Christopher Grubb  
Lend Lease  
Diccon Loxton  
Graham O'Neil  
Rob and Helen Rich  
Andrew Roberts  
The Sherman Foundation  
Peter St George

### SUPPORTERS

Graeme Annabell  
Canadian Tourism Commission  
Estate of the late Clarence E Chadwick  
Estate of the late Kenneth Eaton  
Fairfax Media  
Owen Griffiths & Biodiversity Conservation  
Madagascar Association  
Jacob Grossbard  
Warren Sommerville  
*Sydney's Child*  
Senta Taft-Hendry  
Travel Alberta  
Michael and Mary Whelan Trust  
Estate of the late Gwendoline A West  
Estate of Jessie Campbell Wise

### GIFTS RECEIVED THROUGH THE AUSTRALIAN GOVERNMENT CULTURAL GIFTS PROGRAM

Rod and Robyn Dent in honour of Pat Dent and the Wanindilyaungwa tribe  
Mark Hanlon  
James McColl  
Dr William Rieger  
George Stacey  
David Twine

# nature culture discover

Australian Museum science is freely accessible online at  
[www.australianmuseum.net.au/publications/](http://www.australianmuseum.net.au/publications/)  
ISSN 0067-1975

